University of Kent
at Canterbury

SNORS+

User Manual

Version 6

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CE

This device complies with the requirements of EC directive 93/42/EEC and EN60601-1.

University of Kent at Canterbury

Manufactured by:

Medical Electronics
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SNORS+ is a modular system.
This manual covers the following modules:

- SNORS+ Base Unit
- SNORS Mask (Adult)
- SNORS Mask (Child)
- Linguagraph
- SNORS Audio Unit

Information regarding the use of other manufacturer's devices, specifically as part of the SNORS+ system, is also provided.

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How to use this manual

This manual explains how to use the University of Kent, SNORS+ multiparameter speech workstation. The manual assumes that the hardware and software for the system has already been installed (see the separate "Installation Manual", if not).

SNORS+ allows the simultaneous recording of five key speech parameters, by combining SNORS, Linguagraph and Laryngograph, using a Windows 95® or Windows 98® environment. It is assumed that the reader is already familiar with Windows 95/98®. If you are not used to using this operating system, please refer to your Windows® manual.

Once the hardware and software have been installed, and you are familiar with the use of Windows®, you are ready to read this manual and start using SNORS+. The manual is arranged as follows:

Chapter 1 provides background information on speech production and the three individual instruments – SNORS, Linguagraph and Laryngograph®. This chapter explains why multiparameter assessment is useful and gives outline descriptions of the instruments.

Chapter 2 gives an overview of SNORS+, explaining its features and uses.

Chapters 3, 4 and 5 are "getting started" chapters designed to get you using SNORS+, as a simple, single parameter system, quickly and easily. Chapter 3 describes SNORS-only use, Chapter 4 describes Linguagraph-only use and Chapter 5 describes Laryngograph®-only use. You should read whichever of these chapters relate to your hardware.

Chapter 6 extends the single parameter use of SNORS+ to include all of the basic features.

Chapter 7 shows how to combine SNORS, Linguagraph and Laryngograph® to provide multiparameter assessment.

Chapter 8 describes the remaining features of SNORS+, which are only accessible from the Menu.

Chapter 9 concentrates on those features of SNORS+ that are designed primarily for research use.

Chapters 10, 11 and 12 form a reference section, explaining all of the toolbar, shortcut key, and menu items, respectively.

Chapter 13 provides a system specification.

Windows 95/98® terms used in this manual.

This section describes the basic terms used in the Windows 95/98® environment.

Using the mouse

A mouse works on the principle that you first place your mouse pointer on (point to) something on your screen, and then you click with a mouse button to perform an action on that item.

> **Note:**
>
> All Windows documentation assumes you are right-handed. If you are left-handed, you can switch left and right mouse buttons. For information on how to do this, refer to your Windows® manual.

As you move your mouse, the pointer moves on your screen. If you run out of room, pick up the mouse and place it in another spot.

To point, move the mouse until the tip of the pointer is over the item or area you want to point to. Then you can do the following:

Click

Press and release the left mouse button once.

Double click

Quickly press and release the left mouse button twice.

Right click

Press and release the right mouse button once.

Click and drag

To move an item to another location, first point to it. Press and hold down the left mouse button, and point to where you want the object. Then release the mouse button.

Windows features

Window

Each rectangle on the screen, with a blue “Title Bar” at the top, is a “Window”.

* Title Bar for SNORS+ Window

All windows can have their properties changed or be closed individually, without affecting any other open Windows.

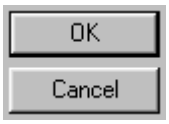
Dialog Box

Windows displays a “Dialog Box” when you must supply information or specify options or properties. For example, when you click the “Open” command to open a file, a dialog box enables you to choose the one you want.

You can use the following types of options in dialog boxes:

Click this:	To do this:
	Expand the list of choices. Then click the item you want.
	Select one option at a time. The circle is filled in when the option is selected.
	Select more than one option at a time. A check mark appears when the option is selected.

Dialog boxes also often contain buttons, which can be clicked to carry out actions or open other dialog boxes. There is usually a button such as “OK”, which is clicked when all the required selections have been made, to implement the selection. There is also often a “Cancel” button, which enables the dialog box to be closed without making any changes.



Message Box

A “Message Box” is like a dialog box except that it doesn’t allow any choices to be made – it simply provides information.

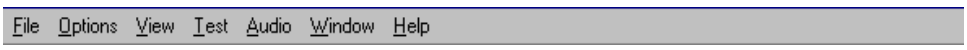
Close box

A “Close Box” is the small square at the top right-hand corner of a window, containing an X.

Clicking in the close box closes the window.

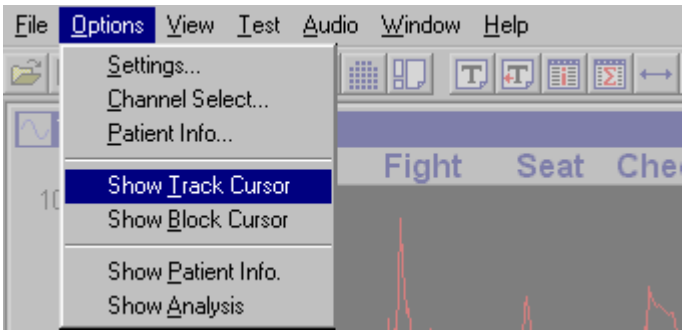
Menu Bar

The “Menu Bar” is the Grey strip at the top of the screen, just below the main title bar.



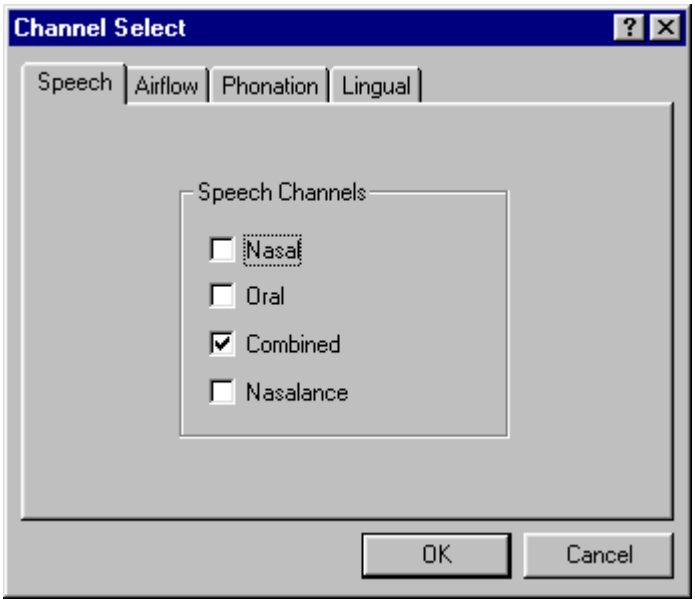
* SNORS+ Menu Bar

Clicking an item in the menu bar opens a drop-down menu, from which selections can be made.



Property page

When many selections need to be made, property pages are often used, allowing like parameters to be grouped together.



The various “pages” can be selected by clicking on their respective tab.

Toolbar

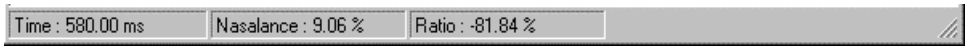
“Toolbars” appear in many programs and provide quick ways to do tasks. Most toolbar buttons correspond to a menu command.

* SNORS+ Toolbar

You can find out what each button does by resting your pointer over the button: a box appears, displaying the button name.

Status bar

The “Status bar”, at the bottom of a SNORS+ window, displays information about a menu command and provides some analysis results.



* Status Bar, showing analysis results

Icon

An “Icon” is a graphical symbol, representing a program or window. Double clicking on an icon opens the appropriate program or window.

Chapter
1

Introduction

What does SNORS+ do?

SNORS+ is a synchronous, multiparameter speech workstation. It can be used for therapy, in real-time, for assessment, and for measurement of outcome. In order to understand why a multiparameter system is necessary, we must first consider how speech is produced.

Speech

Speech is the result of a highly complex and versatile system of co-ordinated muscular movements. The involved structures are known as the articulators. Their movement is controlled neurologically.

The articulators

The respiratory system

Speech sounds are air pressure waves, which, in the majority of cases, are powered by the expiratory phase respiration. During speech, a great deal of control is required.

The larynx

Air passes from the lungs to the larynx. For many of the speech sounds, the vocal folds are used to interrupt the flow of air, causing periodic pulses of air, or phonation. Differing length and mass of vocal folds lead to different fundamental frequencies of vibration: around 125 Hz in men, 200 Hz in women, and 300 Hz in children. During speech, the frequency of vibration changes as pitch is changed in intonation.

The pharynx

The air pressure waves then pass through the pharynx. Its rôle in speech is that of a resonating cavity, the dimensions of which can be altered, e.g. shortened or lengthened, by raising or lowering the larynx.

The velum

During normal respiration, the pharynx is coupled to the nasal cavity – this is also the case during the production of nasal consonants. However, for the vast majority of the consonants of English, the nasal cavity is closed. The velum, which is relaxed during normal respiration, is elevated. The degree of closure necessary is dependent on the sound, and its phonetic context.

The lips

The lips have three functions: a place of closure, further altering the size and shape of the resonation cavity by altering lip shape, e.g. /ʊ/, and a sound source, e.g. during /f/ – upper incisors → lower lip. Air passes through the gap under pressure, causing friction.

The teeth and hard palate

These are not active articulators, but essential contributors.

The tongue

And finally, the tongue: the most versatile of the articulators, being involved in the production of all vowels and the vast majority of consonants. The versatility of the tongue allows:

- horizontal anterior/posterior movement of the body, blade and tip
- vertical superior/inferior movement of the body blade and tip
- transverse concave/convex movement
- spread/tapered contrast in the tongue blade and tip
- degree of central grooving

Different sounds require different tongue configurations. By altering tongue position and shape, the size of the oral cavity, and therefore its resonating characteristics, are changed.

The overall process of speech production

If we take one example of a class of speech sounds – *the plosives* – these require velopharyngeal closure and stopping of the oral cavity. Air pressure builds up in the oral cavity and the rapid release of the closure, + or - voicing, causes the sound. For example, the voiceless alveolar /t/: the superior longitudinal muscle enables the tongue to form a seal around the alveolar ridge and edges of the hard palate. The velum rises as the levator palatini contracts, and closes against the pharyngeal wall. Expiratory air builds up pressure in the oral cavity and this is released as the tongue rapidly comes away from the alveolar ridge.

And that's just one sound. When we consider that the average rate of speech is up to four syllables per second, each of which can contain anything up to seven consonants and a vowel sound, the complexity of articulator movement becomes apparent. It has been estimated that over 100 muscles are involved in the speech process and that their controlled co-ordination requires around 140,000 neuromuscular events every second.

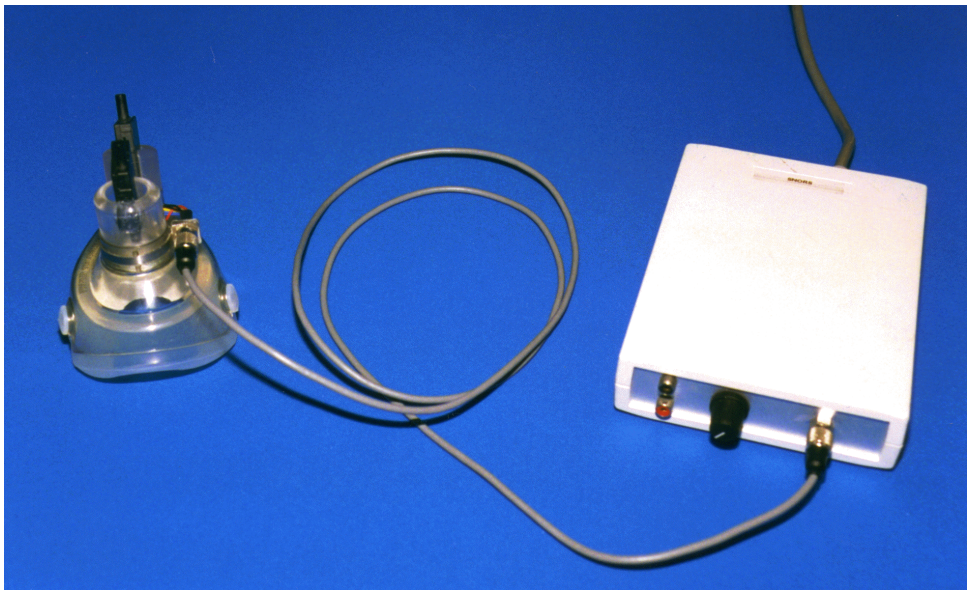
With a process this complex, how can we hope accurately to assess, and measure the involvement of all the contributing parameters? And – as important – how can we objectively measure change in these, e.g. as a result of therapy? There are a number of individual instruments that can help us do this, including SNORS, Linguagraph and Laryngograph.

Speech instruments

SNORS

SNORS is an anemometry system that measures both nasal and oral airflow, during speech. By calculating the percentage of the airflow that is nasal (Nasalance), SNORS provides a measure of the effectiveness of velopharyngeal closure. As both nasal and oral airflows are measured, SNORS is virtually unaffected by the loudness of the sound and so determines not merely whether closure has occurred but also the degree of closure. In addition, SNORS uses fast sensors, thus allowing the rapid movements of the velum to be detected.

SNORS utilises a lightweight, transparent, two-chamber facemask, which is held over the nose and mouth, during speech. As well as measuring airflow, both nasal and oral speech sounds are detected, using small microphones within the mask. These speech signals are presented on a computer screen as “envelope” waveforms, which provide a simple, clear indication of speech intensity, over time. The airflow signals appear on the screen, below the speech intensities, allowing the airflow to be related to the resultant sound.

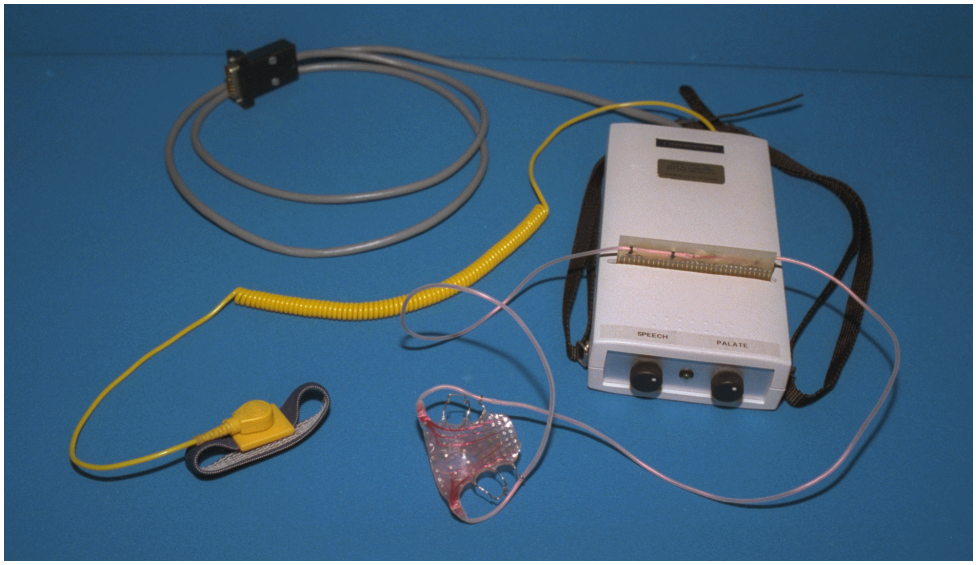


Linguagraph

Linguagraph is an electropalatography system. Electropalatography:

- Uses a special artificial palate to determine tongue-palate contact.
- A small electrical signal is fed to the patient.
- The signal passes, via the tongue and palate, to a computer.
- Contact patterns are displayed on the computer.

The Kent *Linguagraph* is a user-friendly, *clinical* electropalatography system. It comprises a small electronics unit, which connects between the patient’s palate and the PC.



The artificial palate used is that developed at the University of Reading, as this has become the *defacto* standard in the UK. The palate is custom-made and simply clips to the upper teeth, by means if thin wire dental cribs.

Laryngograph®

Laryngograph® is a commercial electroglottograph, developed and manufactured by Laryngograph Ltd, which measures vocal fold activity. This is achieved by placing a pair of electrodes on the patient's neck, either side of the thyroid cartilage. By passing a small electric current through the vocal folds, it is possible to detect their vibration as well as simple movements of the glottis.

Multiparameter assessment

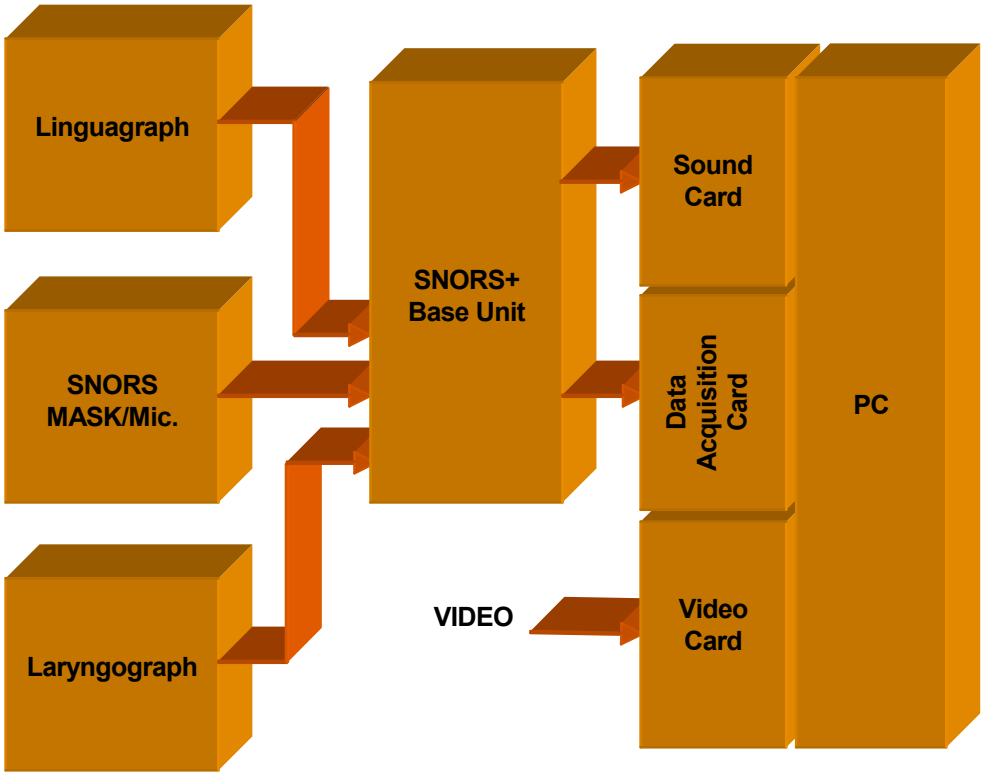
These instruments allow measurement of key articulators individually. However, as speech involves the co-ordinated movement of the various articulators, it is also important to be able to measure several articulators simultaneously.

Chapter
2

Overview of SNORS+

An introduction to the SNORS+ multiparameter system

SNORS+ is a Windows 95/98® version of the University of Kent SNORS nasal/oral airflow system. As well as being a stand-alone SNORS system, SNORS+ also allows the addition of the Kent Linguagraph electropalatography system and/or the Laryngograph® electroglottograph; i.e. it is SNORS **plus** other instruments (the other instruments can also be used without SNORS). In addition to the new software, SNORS+ incorporates a simple interface, to enable the connection of the extra instruments to the computer's standard SNORS data acquisition card.



SNORS+ allows simultaneous measurement of five key parameters of speech production, in real-time. Parameters can be displayed as scope, or trend, waveforms over time, or as 2-D, dynamic displays. Additionally, Wave displays provide high-resolution views, and synchronous audio playback facilitates accurate identification of waveform features. Optional Video recording and playback allows simultaneous viewing of the above parameters along with a video image (e.g. videofluoroscopy).

SNORS+ can be used for therapy in real time, for assessment, or for the measurement of outcome.

Speech parameters measured

- Speech outcome
- Respiration
- Voicing
- Velopharyngeal closure
- Tongue-palate contact

Display options

Trend channels available

- Nasal speech intensity
- Oral speech intensity
- Combined speech intensity
- Acoustic nasalance
- Nasal airflow
- Oral airflow
- Combined airflow
- Aerodynamic nasalance
- Aerodynamic ratio
- Voicing (Lx) intensity
- Fundamental frequency (derived from Lx waveform)
- Closed quotient (derived from Lx waveform)
- Short-term Shimmer (derived from Lx waveform)
- Short-term Jitter (derived from Lx waveform)
- Alveolar tongue-palate contact
- Palatal tongue-palate contact
- Velar tongue-palate contact
- Left tongue-palate contact
- Centre tongue-palate contact

- Right tongue-palate contact
- Tongue contact balance
- Tongue contact centre-of-gravity
- Tongue contact weight

2-D displays available

- Tongue-palate contact (**EPG**)
- Bi-directional **bar** (any two real-time scope channels)
- **Video** image

Wave displays available

- Sound Waveform (Sp)
- Laryngograph waveform (Lx)

Speech analysis displays available

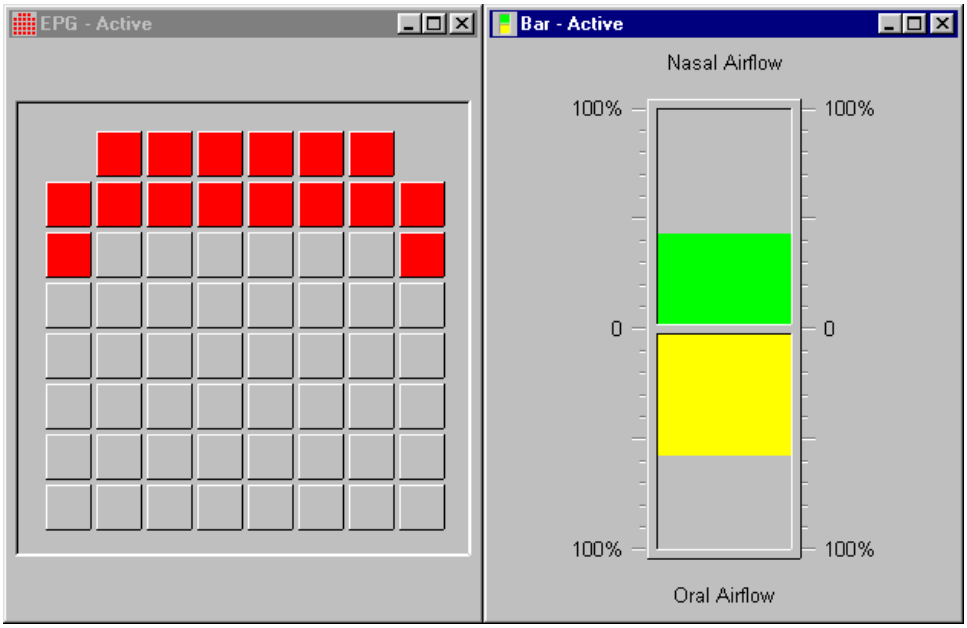
- FFT
- LPC
- Spectrogram

Use

SNORS+ measures the function of key articulators. It can be used for therapy, assessment and the measurement of outcome.

Real-time display – therapy

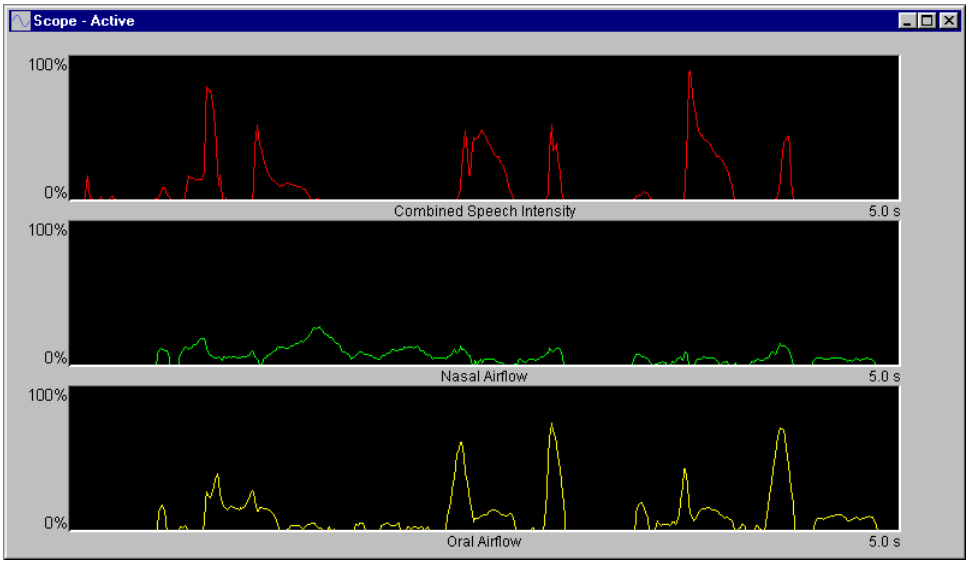
In therapy, real-time displays of function are provided. These can be instantaneous, 2D displays, showing single or multiple parameters, such as tongue/palate contact and nasal/oral airflow.



These simple 2D displays are generally the most useful for therapy, as they are simple and easy to interpret. They provide clear visual feedback to the patient, allowing the effect of any corrections made to be seen.

SNORS biofeedback, for example, helps the patient to know when velopharyngeal closure is happening, to become aware of exactly what is happening in their mouth, and any sensation that accompanies that. Small adjustments that the patient tries can be seen to either work or not. A visual image helps with self monitoring: initially the patient can see what is happening and can be repeatedly asked to explain what is happening, and what things feel and sound like. And because we could see and record changes and improvements, patients are encouraged to continue, and can be motivated to work hard.

As well as instantaneous displays, trend displays can also be provided. Although these are more complicated, they do provide additional information about the dynamics of the articulations.

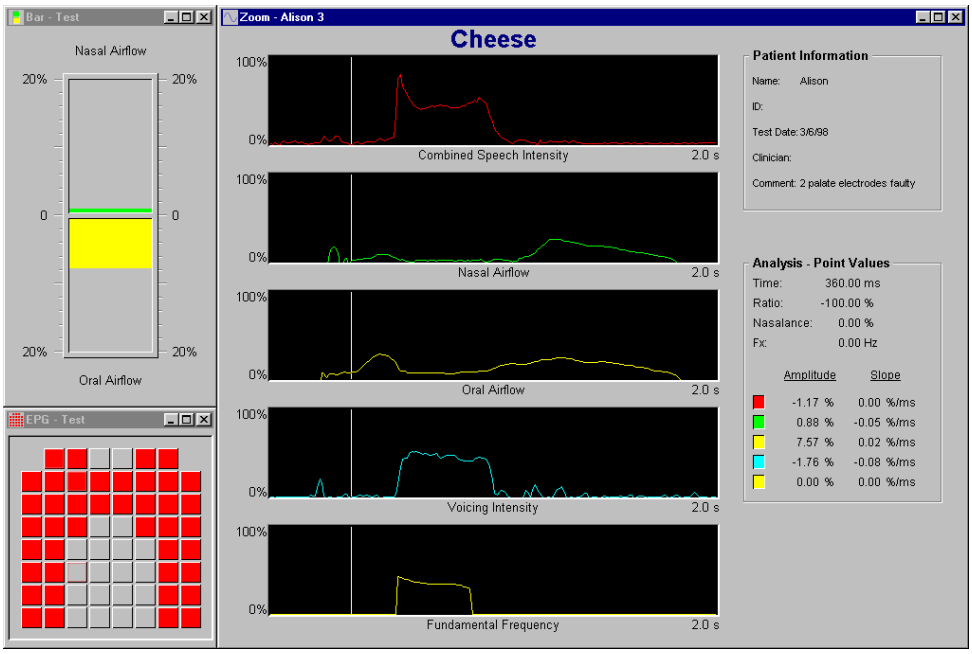


Although a lot is happening on a trend display, the display can easily be paused, either manually or automatically at the end of a scan. It is then possible to discuss the

display with the patient and to show what is happening and what needs to be done to correct for any shortcomings.

Analysis display – assessment and measurement of outcome

For assessment and analysis, a test routine is provided. This prompts the patient to say a sequence of words (from a default or user-defined word list) and records the results from whatever instruments are selected. At the end of the test, comprehensive displays are provided.



Analysis is carried out using cursors to calculate parameters at single points, or over selected periods of the speech.

Chapter
3

Getting started – SNORS

How to start using SNORS

This chapter provides a quick introduction to using SNORS+ as a stand-alone, Anemometry-only system.

Connecting the hardware

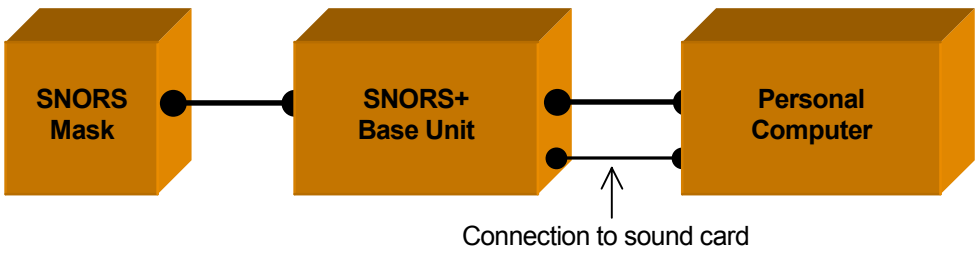
Before using SNORS+, it is necessary to connect the hardware together. This should have been carried out at installation, but the hardware may have been subsequently disconnected, e.g. for transportation. Also, you may wish to change between adult and child masks (if you have both types). If the hardware is not already correctly configured, proceed as follows.

1) Make sure that the computer is switched off and unplugged from the mains.

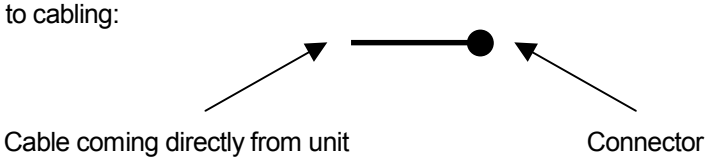
2) Connect the SNORS+ Base Unit (large connector at rear) to the interface card installed in the computer, using the Data Cable. This is the thick cable with a large, flatish, 37-pin plug on each end. Note that the connectors are shaped and will only fit one way round in their sockets. Both ends of the cable are identical, however, so it does not matter which end is connected to which item.

3) Plug the SNORS Mask lead into the appropriate connector on the front of the SNORS+ Base Unit. Look at the connectors, before mating them and align the red mark on the plug with the corresponding red mark on the socket. Gently push the two appropriate connectors together and rotate the plug, if necessary, until the two start to move together. When this occurs, you can push the two fully together.

4) Connect the SNORS+ Base Unit's audio output to the PC Sound Card's "Line In" socket, using the Audio Cable provided. This is the lead with a small. 3.5 mm mini-jack plug on each end. It does not matter which way round the lead is.



Key to cabling:



5) Now plug in and switch on the computer. Once it has booted (this may take a few minutes) the system is ready to use.

Setting up

This section describes how to start up SNORS+ and check for correct operation. It is recommended that this simple procedure be carried out at the start of each session (i.e. with each new patient).

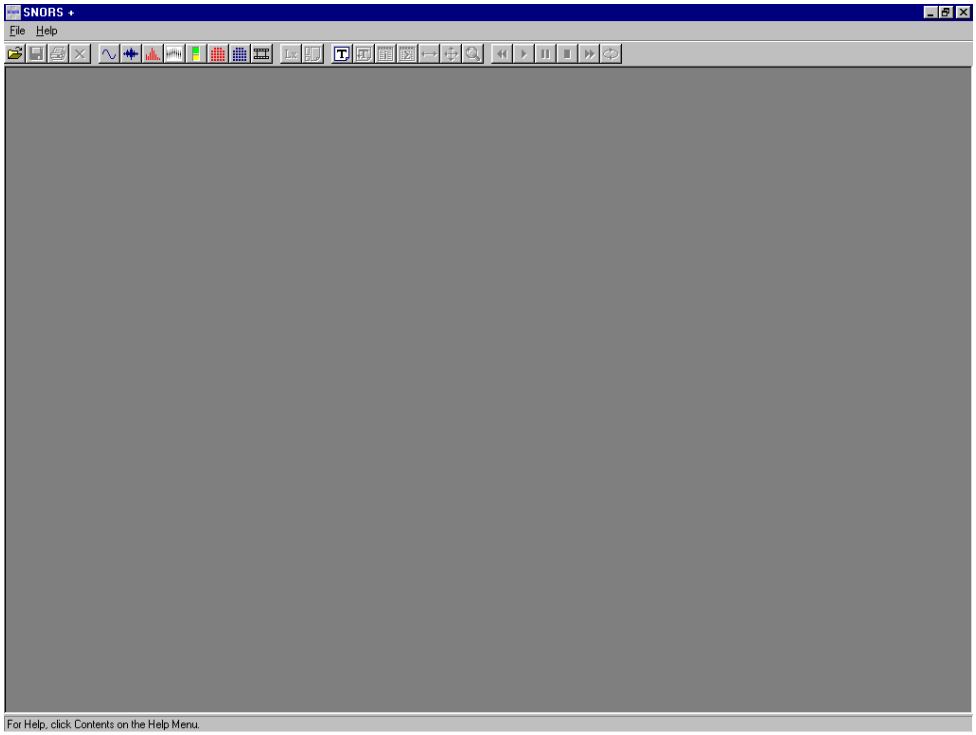
This is important for the following reasons:

- It allows the patient to get used to speaking into the mask.
- It allows the therapist to check that the mask is held correctly against the face, with no gaps.
- It allows the volume control to be set to the correct value for each particular patient.
- It allows the operation of the system to be discussed with the patient.

Open the SNORS+ program by double clicking on its icon.

A title screen appears briefly.

The main SNORS+ window then appears on the screen.



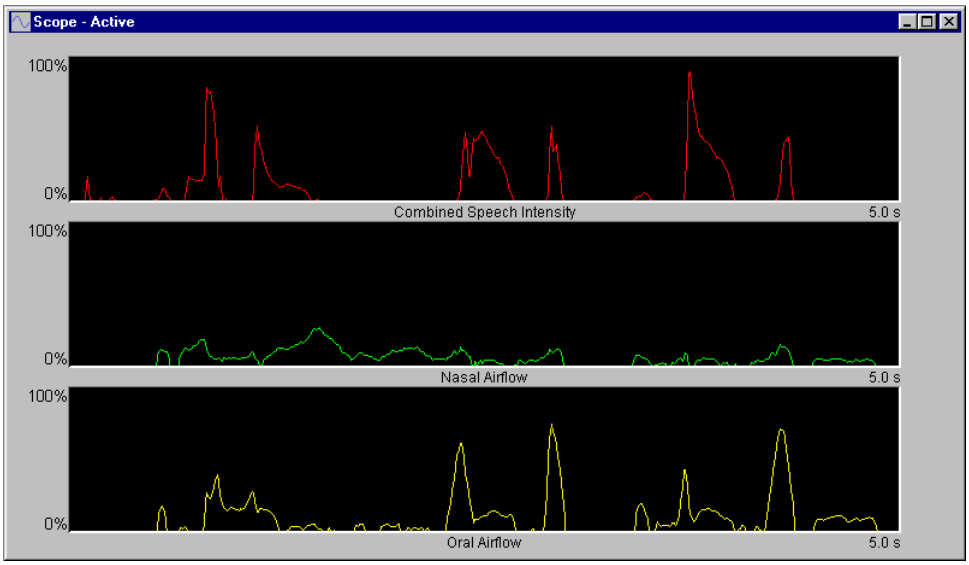
Note that many of the buttons are "Greyed out". This is because they are not available yet. In general, an option is greyed out whenever it is not available. This may be because the option is not relevant at the time, or it may be because the necessary hardware (e.g. a sound or video card) is not present.

Start a scope display by clicking on the "New Scope" button on the toolbar.

A scope window opens.

Now remove the red flow-sensor caps from the mask (if they are present) and ask the patient to place the mask over their nose and mouth, ensuring a good, comfortable fit. Make sure that there are no gaps around the outside of the mask, and that the patient is not obstructing the airflow with their fingers.

Ask the patient to speak into the mask. Watch the three traces on the screen and make sure that they all show some movement.



Adjust the volume control on the SNORS hardware unit (The black knob on the front of the unit) until the upper (red) “Combined Speech intensity” trace deflects by a good amount, but does not quite reach the top of its window (as shown in the example above).

When you are happy with the operation of the system, click the “Close All” button, on the toolbar.

The system is now ready to use.

Therapy

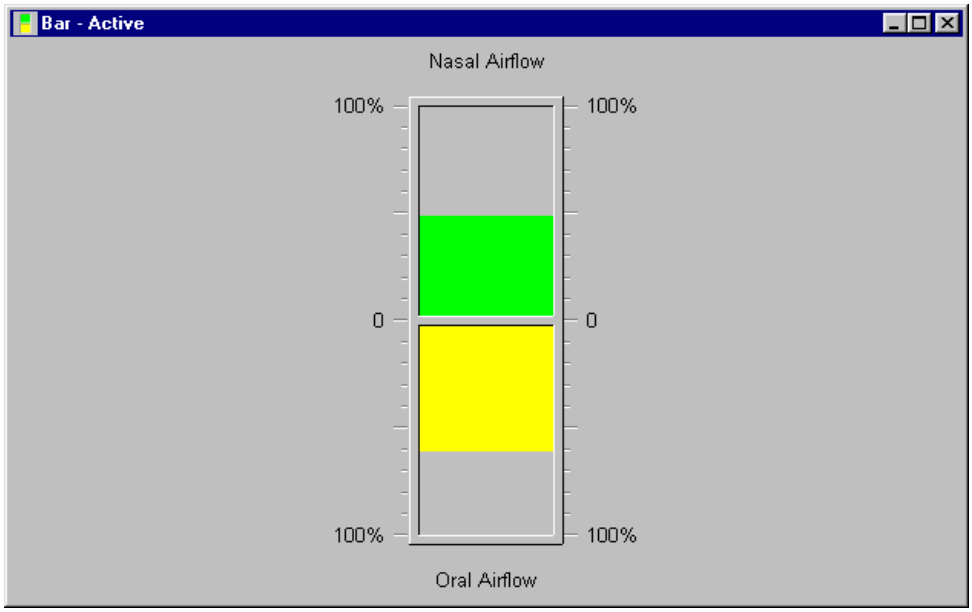
Bar

To open the therapy bar, click “New Bar” on the toolbar.

A bar window appears.

The bar can be enlarged to fill the SNORS+ window by clicking the “Auto Arrange” button, on the toolbar.

The upper section of the display shows the amount of nasal airflow, as a green bar, which moves upwards away from the centre. The lower section indicates oral airflow as a yellow bar, which moves downwards away from the centre.



Ask the patient to place the mask over their nose and mouth, ensuring a good seal, and observe the airflows as they speak. Bar is a very useful biofeedback tool, as it provides a simple, clear display of nasal and oral airflow. This allows patients to monitor their airflows, make corrections, and observe the result. Bar is particularly useful when working with sustained sounds or single phonemes.

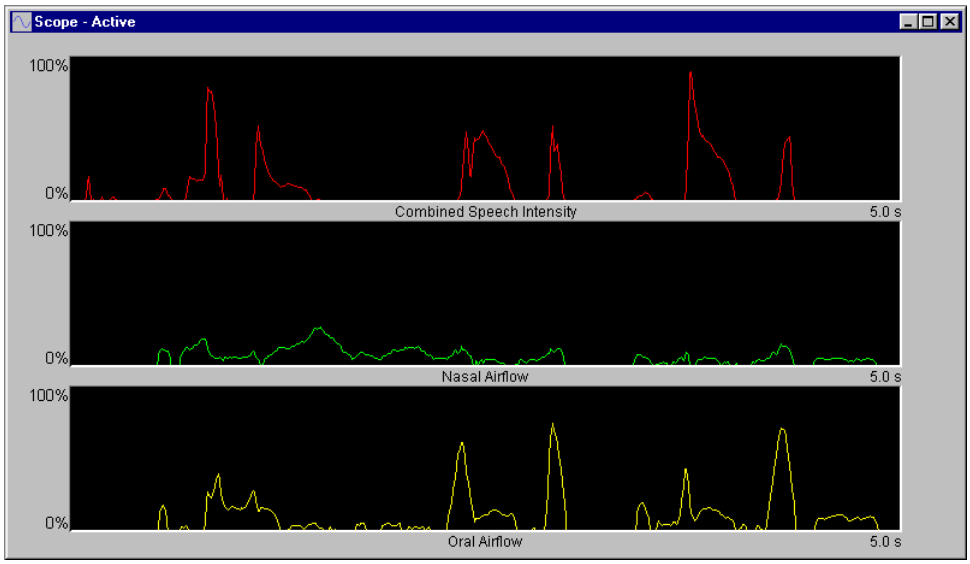
When you have finished, close the bar by clicking the “Close All” button on the toolbar.

Scope

To open the therapy scope, click “New Scope” on the toolbar.

Enlarge the display by clicking “Auto Arrange”, on the toolbar.

Three traces appear, scanning across the display.



As for Bar, ask the patient to place the mask over their nose and mouth, ensuring a good seal, and observe the traces as they speak. Scope is also useful in therapy as it allows patients to observe the dynamics of their speech. Thus, it is useful when working with clusters or words.

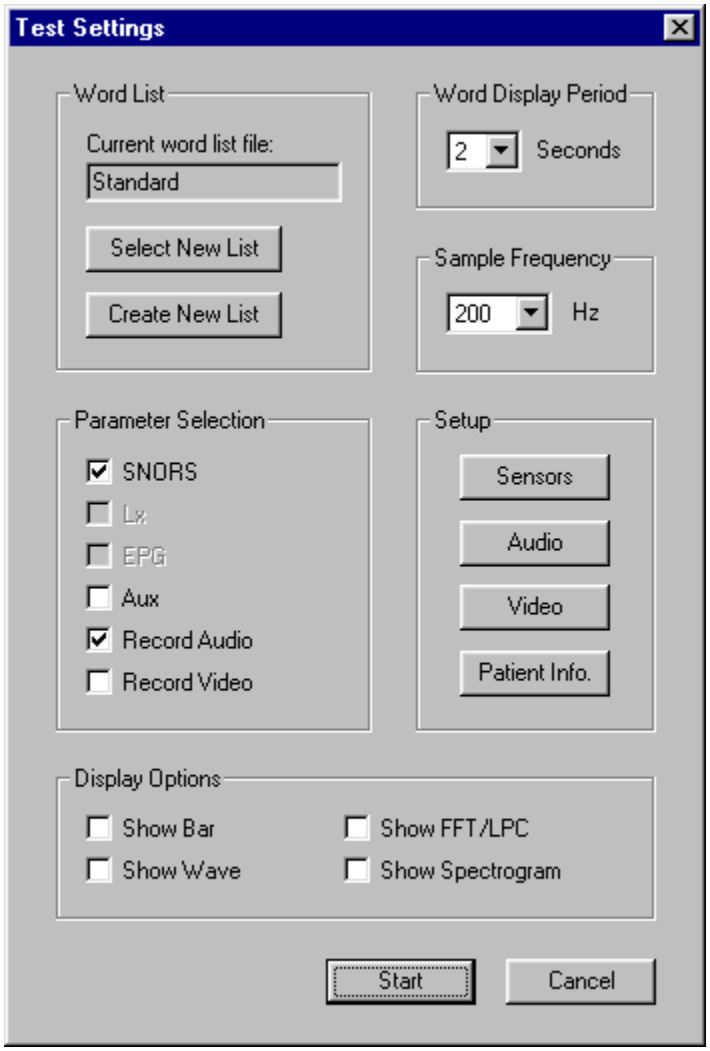
When you have finished, close the scope by clicking the "Close All" button on the toolbar.

Assessment

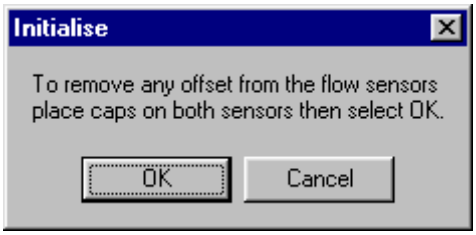
Test

To perform an assessment test, click "New Test" on the toolbar.

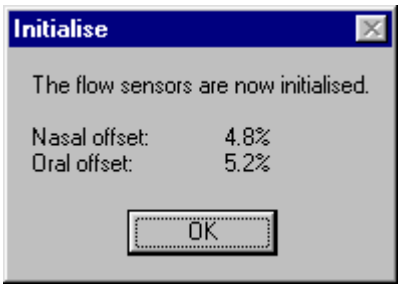
The "Test Settings" dialog box opens.



As this is the first test of the current session, you will be prompted to initialise the flow sensors. A message box appears.



Make sure that the red caps are on the flow sensors, put the mask down on a flat surface, and then answer "OK" by clicking the "OK" button in the message box. A new message box appears, showing the sensor offsets[1].



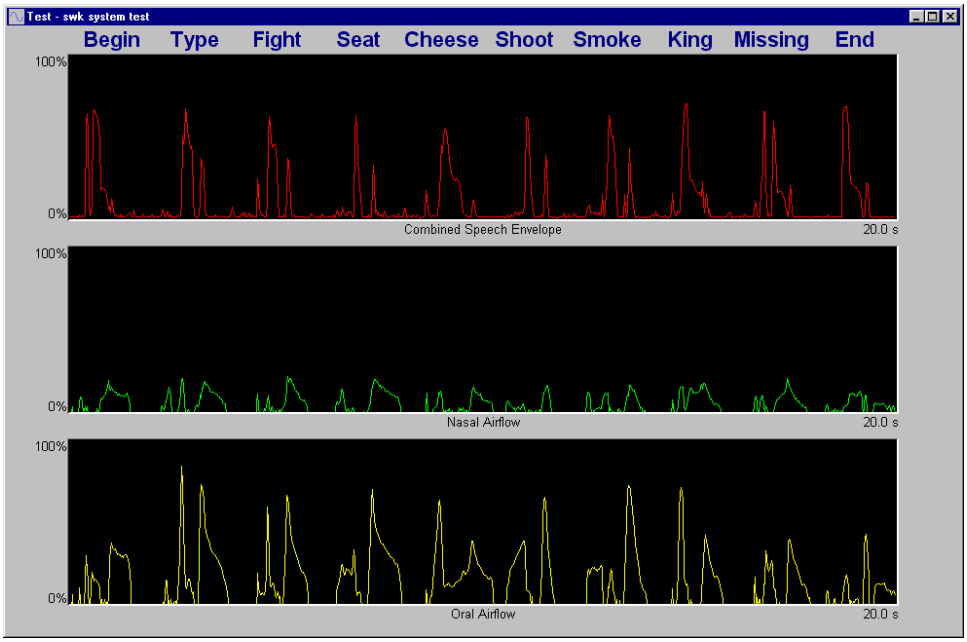
Again, click "OK". The sensors are now initialised, and you can remove the red flow sensor caps, ready to perform the test.

When you are ready to commence the test, click "Start" in the "Test Settings" dialog box.

After a short delay, a sequence of words appears on the screen. The standard sequence is "Begin, Type, Fight, Seat, Cheese, Shoot, Smoke, King, Missing, End".

[1] The sensor offsets are small errors that exist; such that the sensors do not read exactly zero, for no flow. The initialisation process removes these errors, which are typically, a few percent. If the errors exceed about 6%, it is advisable to have the system recalibrated.

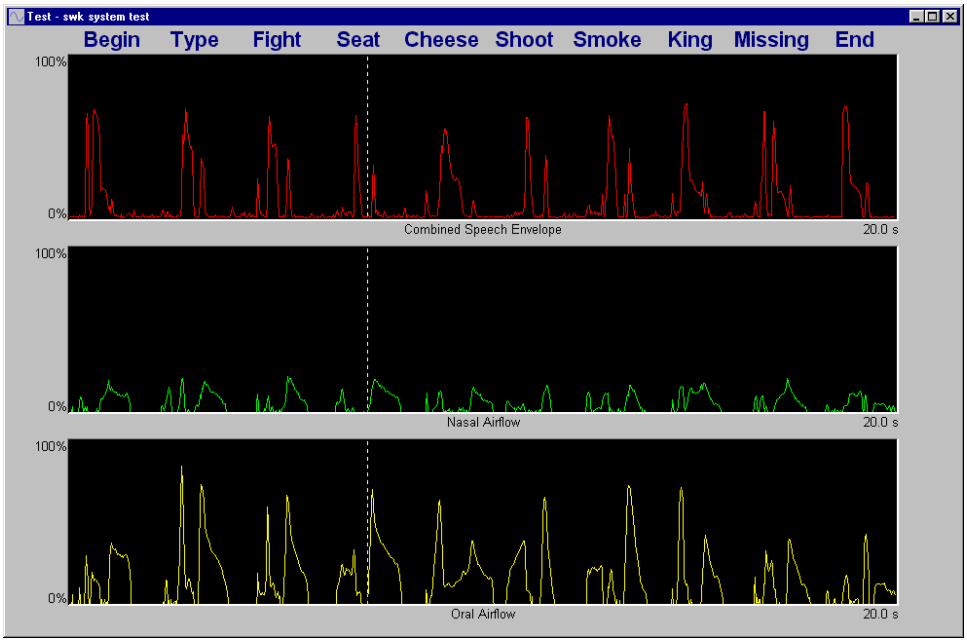
The patient is simply required to speak the words into the mask. At the end of the test, a Test display (similar to Scope) appears on the screen, showing the waveforms for the complete word list.



The sensitivity of the traces can be changed, if required, by pressing the **+** or **–** key on the **numeric keypad**. This is useful if the patient has spoken very quietly, for example, and the initial traces are low in amplitude. As the sensitivity is varied, the scales at the left of the screen alter to reflect the changes.

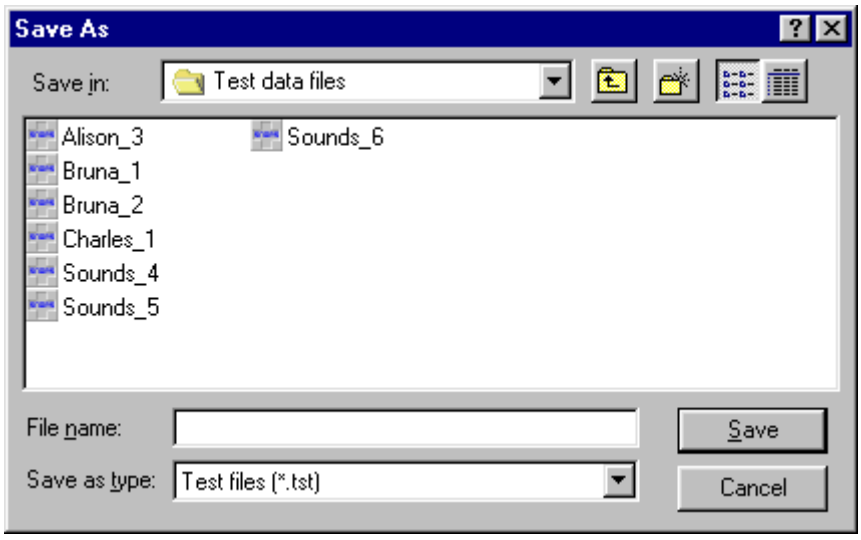
To listen to the recorded test, click “Play” on the toolbar.

The recorded sound is replayed and an animation cursor moves along the Test waveforms, in synchronism with the sound.



To save the test results click “Save” on the toolbar.

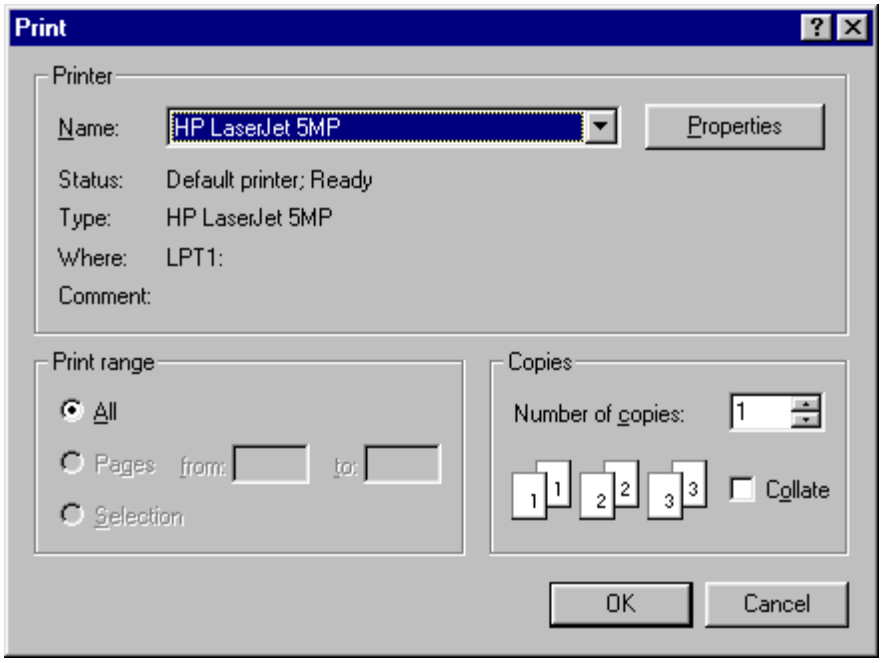
The “Save As” dialog box appears.



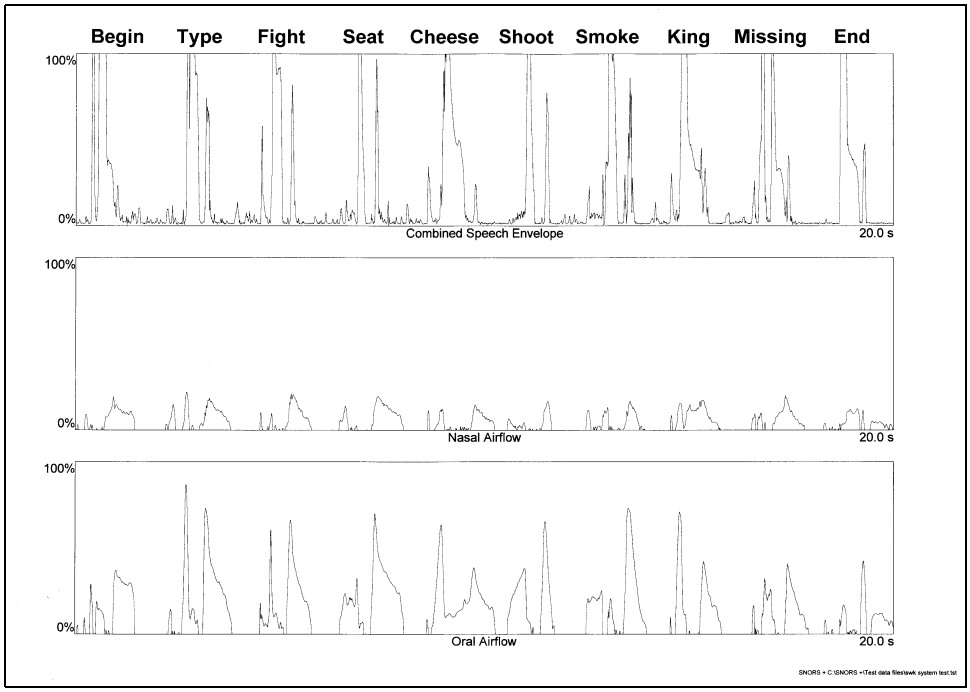
Type in a file name of your choice and then click “Save”.

To print the test, click “Print” on the toolbar.

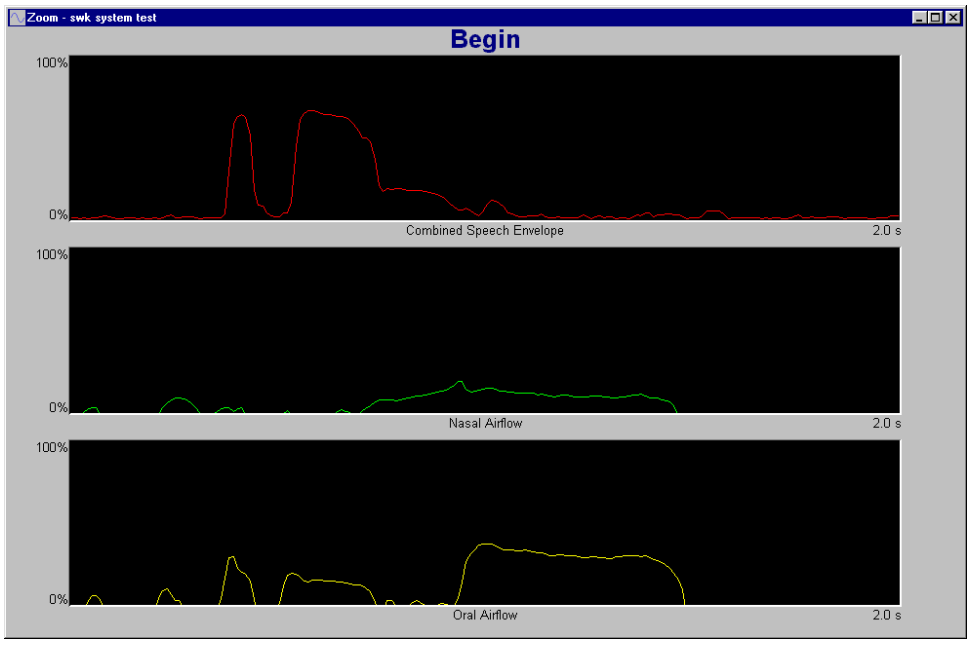
When the “Print” dialog box appears, click “OK”. [Note that the print dialog box is part of Windows 95/98® and will vary in appearance and function, according to your printer.]



When you click “OK” a simple graphical printout of the Test screen will be produced.



To view a particular word in more detail, double click the screen, anywhere within the region of the chosen word (on either the text or the trace). A new window opens, showing just this word.

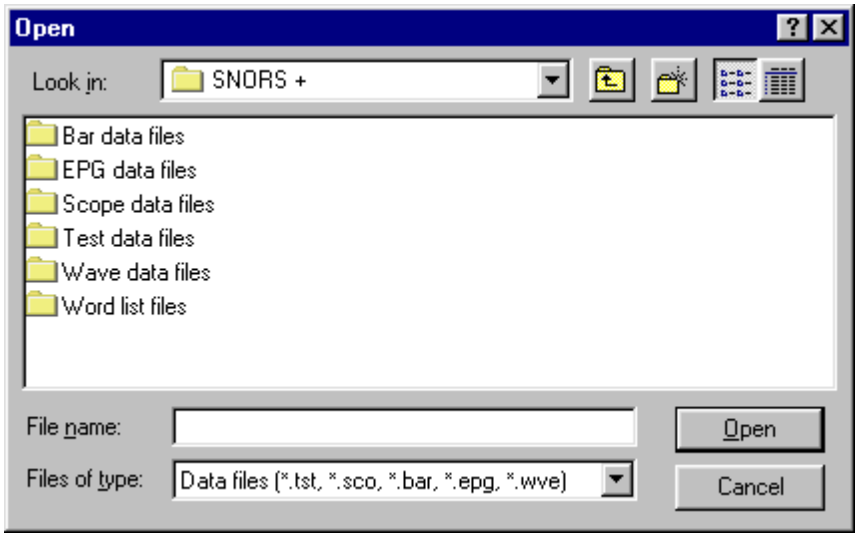


To close the test window, click on the “Close All” button, on the toolbar.

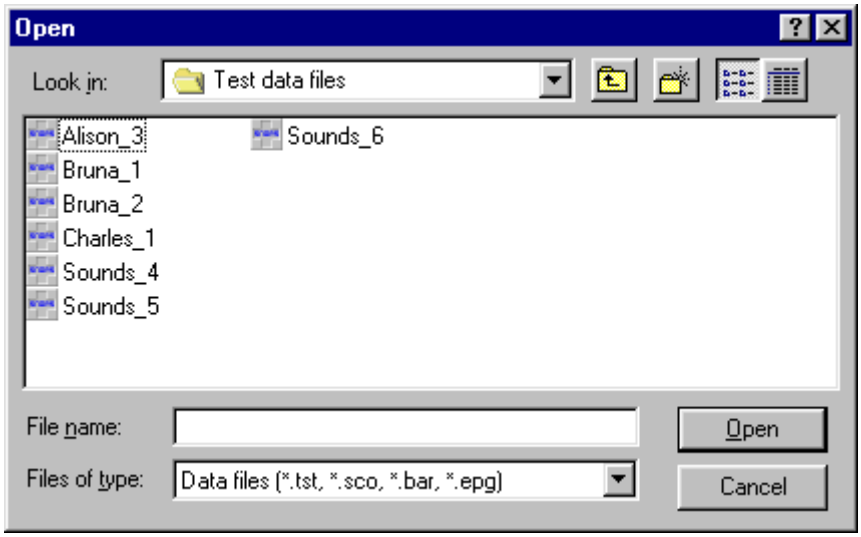
Open

To open a previously saved test file, click “Open” on the toolbar.

In the dialog box that appears, double click on the “Test data files” folder.



This will open the folder containing previous SNORS+ tests.



Next, click on the file that you wish to open and then click "Open". A Test display for the chosen test appears on the screen. This is the same as a test window appearing at the end of an assessment test (see above).

When you have finished using SNORS+, close the program by clicking on its "Close" box, in the top right-hand corner of the display.

Note regarding opening of SNORS (DOS) legacy files

Both Dos and Windows allow file names to have an optional “extension” separated from the main file name by a dot (e.g. Mytest.tst – here Mytest is the file name and tst is the extension). SNORS+ follows the Windows convention of automatically appending an extension when files are saved. Thus, all SNORS+ test files have the extension .tst.

DOS, on the other hand, often allows the user to add whatever extension they wish (if any). Hence legacy SNORS (DOS) test files may have any or no extension.

By default, SNORS+ only shows data files with extensions that it uses. These are:

.tst for test files

.sco for scope files

.bar for bar files

.epg for Linguagraph electropalatography files

.bmp for video image files

.wve for audio wave files

.fft for FFT/LPC files

spg for spectrogram files

To open a SNORS (DOS) file, it is necessary to select “All files (*.*)” from the “Files of type:” drop down box. This will display all files, whatever their extension. SNORS+ will check the selected file to ensure that it is a SNORS or SNORS+ file, and then open it.

If you are likely to want to access the file again, using SNORS+, it is recommended that you re-save it in SNORS+. This will save the file in the SNORS+ format, which will mean that it appears by default in the Open dialog box, in future. The saved file will be an additional file and will not overwrite the original DOS file (unless the original file had a .tst extension).

Chapter

4

Getting started – Linguagraph

How to start using Linguagraph

This chapter provides a quick introduction to using SNORS+ as a stand-alone electropalatography-only system.

Connecting the hardware

Before using SNORS+, it is necessary to connect the hardware together. The basic setup should have been carried out at installation, but the hardware may have been subsequently disconnected, e.g. for transportation. If the hardware is not already correctly configured, proceed as follows.

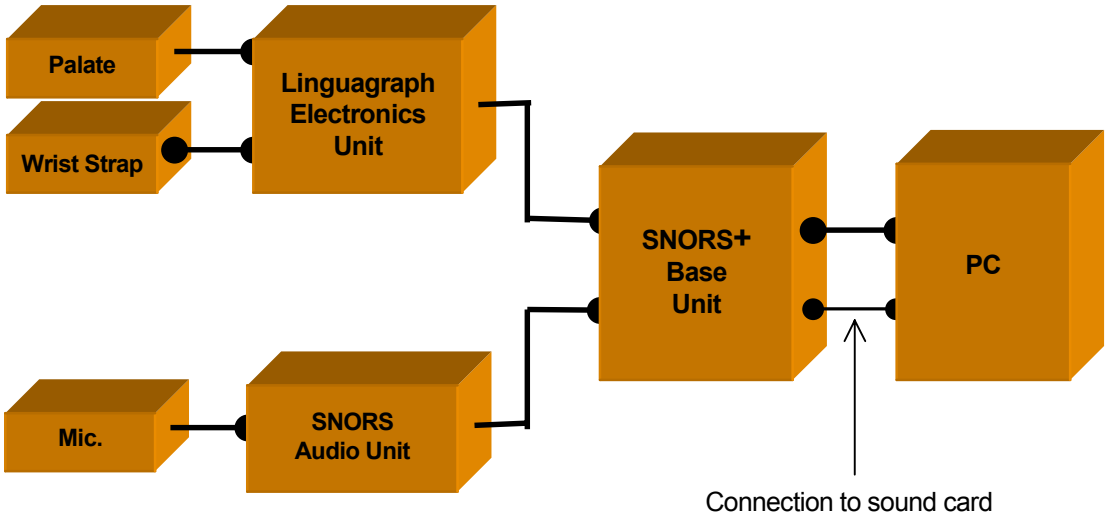
1) Make sure that the computer is switched off and disconnected from the mains.

2) Connect the SNORS+ Base Unit (large connector at rear) to the interface card installed in the computer, using the Data Cable. This is the thick cable with a large, flatish plug on each end. Note that the connectors are shaped and will only fit one way round in their sockets. Both ends of the cable are identical, however, so it does not matter which end is connected to which item.

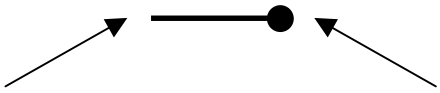
3) Plug the Linguagraph lead into the appropriate connector on the front of the SNORS+ Base Unit. (For a single Linguagraph, use the Linguagraph 1 socket). Look at the connectors, before mating them and align the red mark on the plug with the corresponding red mark on the socket. Gently push the two appropriate connectors together and rotate the plug, if necessary, until the two start to move together. When this occurs, you can push the two fully together.

4) Plug the SNORS Audio Unit lead into the appropriate connector on the front of the SNORS+ Base Unit (labelled Mask/Mic.). Look at the connectors, before mating them and align the red mark on the plug with the corresponding red mark on the socket. Gently push the two appropriate connectors together and rotate the plug, if necessary, until the two start to move together. When this occurs, you can push the two fully together. Plug the microphone into the connector at the front of the SNORS Audio Unit.

5) Connect the SNORS+ Base Unit's audio output to the PC Sound Card's "Line In" socket, using the Audio Cable provided. This is the lead with a small. 3.5 mm mini-jack plug on each end. It does not matter which way round the lead is.



Key to cabling:



Cable coming directly from unit Connector

6) Now plug in and switch on the computer. Once it has booted (this may take a few minutes) the system is ready to use.

Setting up

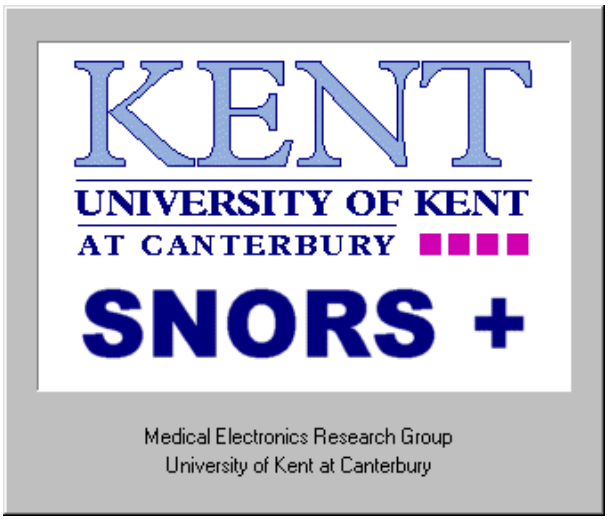
This section describes how to start up SNORS+ and check for correct operation. It is recommended that this simple procedure be carried out at the start of each session (i.e. with each new patient).

This is important for the following reasons:

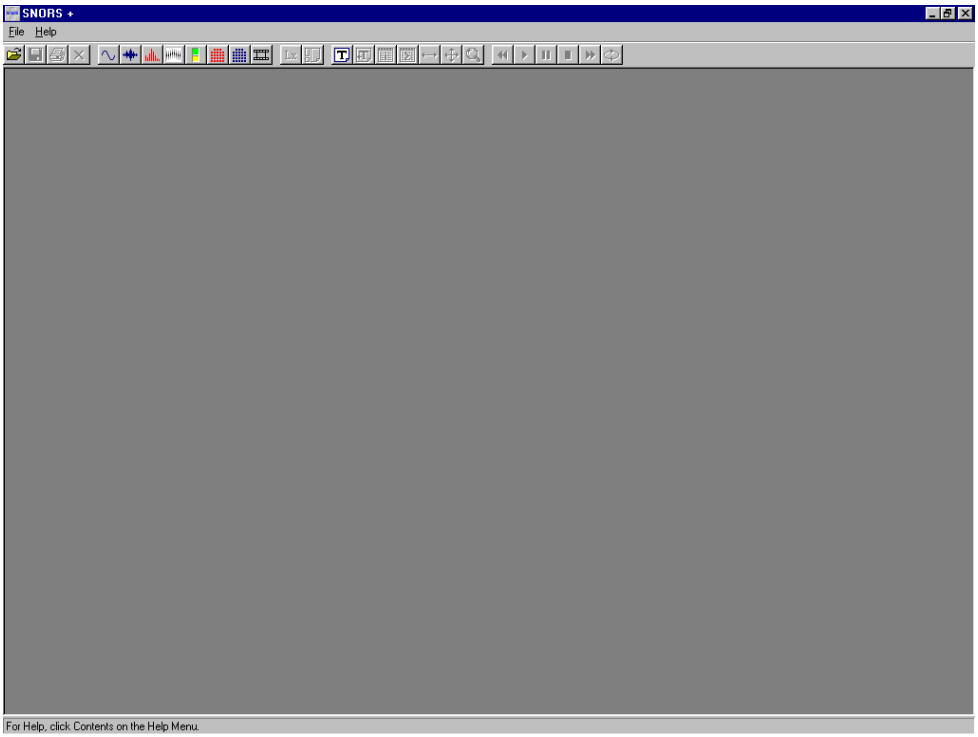
- It allows the patient to get used to speaking with an artificial palate.
- It allows the therapist to check that the palate is correctly fitted and to adjust the sensitivity control to suit each patient.
- It allows the volume control to be set to the correct value for each particular patient.
- It allows the operation of the system to be discussed with the patient.

Open the SNORS+ program by double clicking on its icon.

A title screen appears briefly.



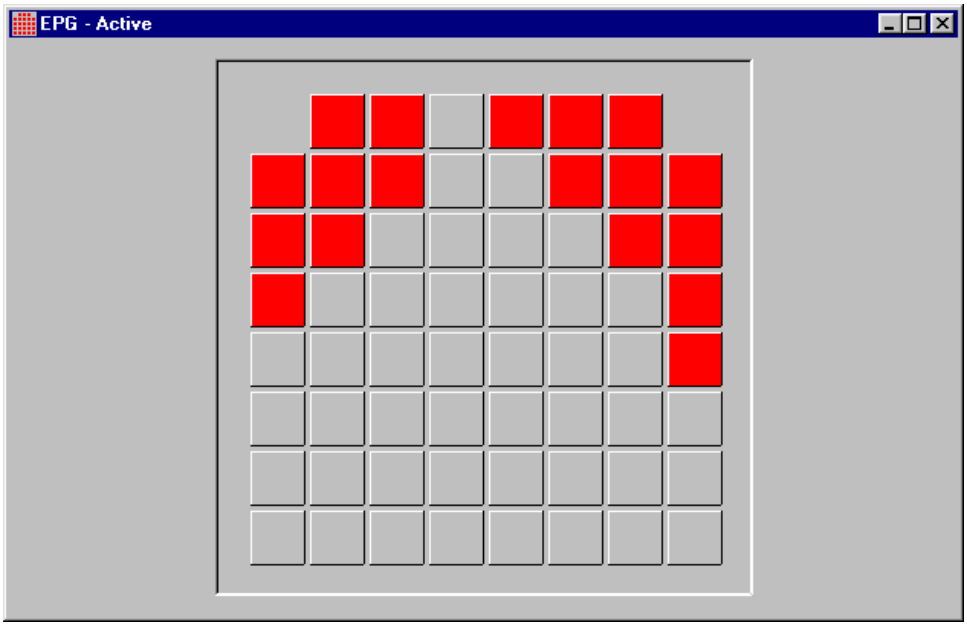
The main SNORS+ window then opens.



Note that many of the buttons are "Greyed out". This is because they are not available yet. In general, an option is greyed out whenever it is not available. This may be because the option is not relevant at the time, or it may be because the necessary hardware (e.g. a sound or video card) is not present.

Start an EPG display, by clicking on the red "New EPG" button on the toolbar.

An EPG window opens.



Place the Linguagraph electronics unit so that it hangs around the patient's neck by means of its strap. Place the electropalatography palate in the patient's mouth, ensuring a firm, comfortable fit, and plug the palate connector into the slot in the Linguagraph unit. Note that the connector will only fit one way round. Place the wrist strap over the patient's wrist, ensuring that the connecting lead is positioned at the inside of the wrist. Now ask the patient to place their tongue firmly against their hard palate. Adjust the Linguagraph sensitivity control so that maximum contact is just shown (ideally, all squares should be lit). Then ask the patient to take their tongue away from the palate and check that no (or very little) contact is shown.

Note on electropalatography palates

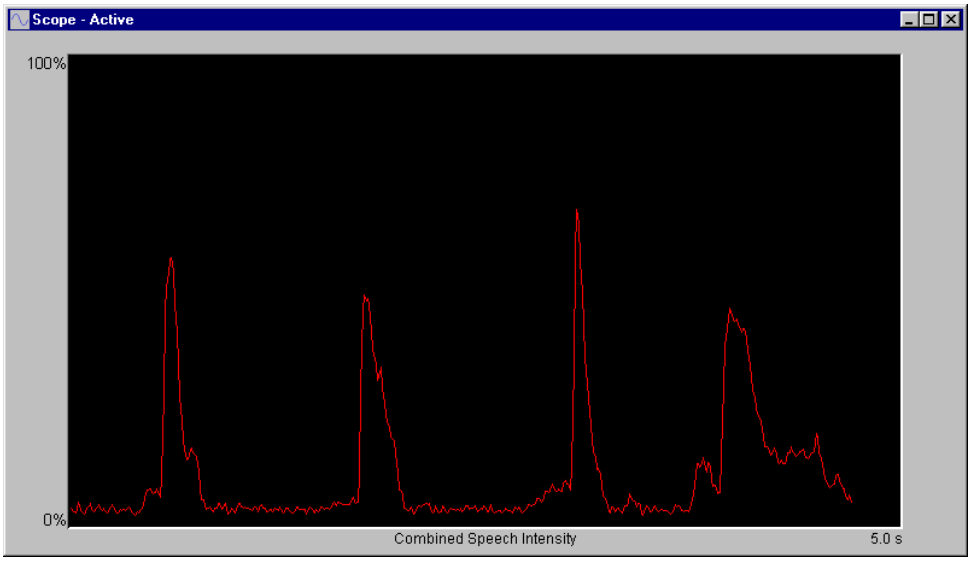
It takes a while for the patient to get used to wearing an electropalatography palate. For this reason, the palate should be inserted some time prior to commencement of assessment or therapy. Opinions vary as to how long should be allowed, but a minimum period of one hour is recommended.

Before using electropalatography with a patient for the first time, it is advisable to issue them with a "practise palate". This is a low-cost acrylic palate, made from the same impression as the electropalatography palate, but without electrodes or wires. The patient should be asked to wear their practise palate for an hour or so a day, if possible for several weeks prior to therapy. [A practise palate is not necessary for patients who wear upper dentures.]

When you are happy with the operation of the Linguagraph system, click the "Close All" button, on the toolbar.

Now start a scope display by clicking on the "New Scope" button on the toolbar.

A scope window opens.



Place the microphone a suitable distance from the patient's mouth. In most cases, clipping it to the Linguagraph neck cord, just above the Linguagraph unit, is satisfactory.

Ask the patient to speak and watch the trace on the screen. Adjust the volume control on the SNORS hardware unit (The black knob on the front of the unit) until the trace deflects by a good amount, but does not quite reach the top of its window (as shown in the example above).

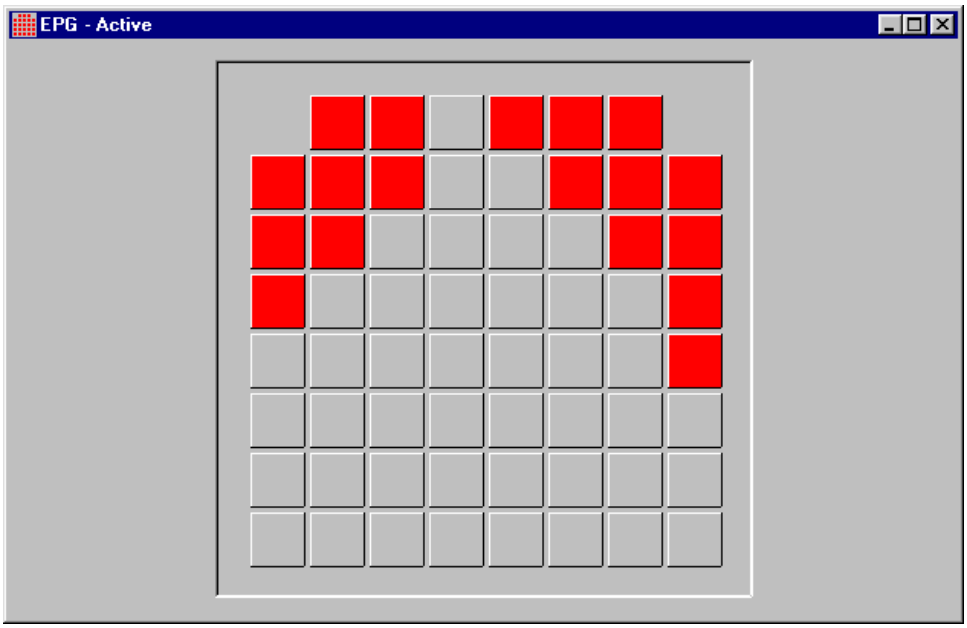
When you are happy with the operation of the system, click the "Close All" button, on the toolbar.

The system is now ready to use.

Therapy

To open the therapy EPG window, click on the “New EPG” button on the toolbar.

An EPG window will open.

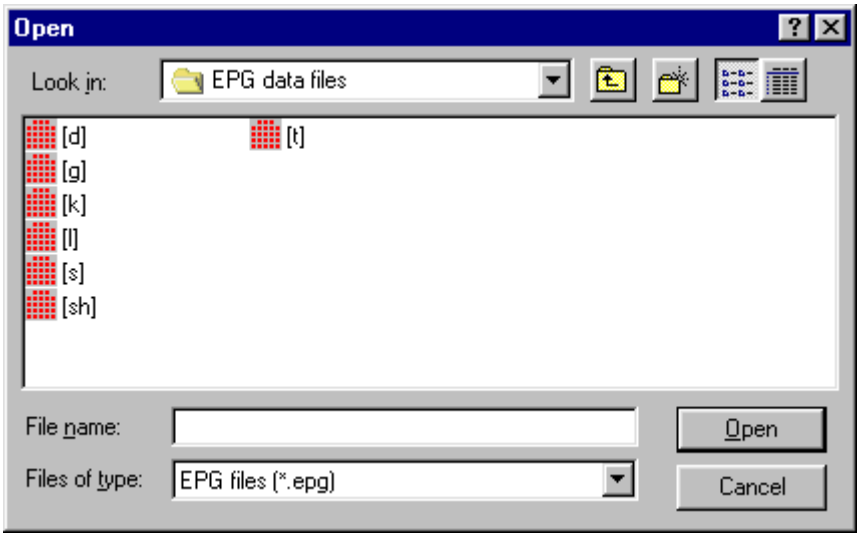


The EPG window can be enlarged to fill the SNORS+ window by clicking the “Auto Arrange” button on the toolbar.

Ask the patient to produce the required sounds or words and observe the display, with the patient. The display can be paused by pressing the “Pause” key and restarted by pressing the “Pause” key again.

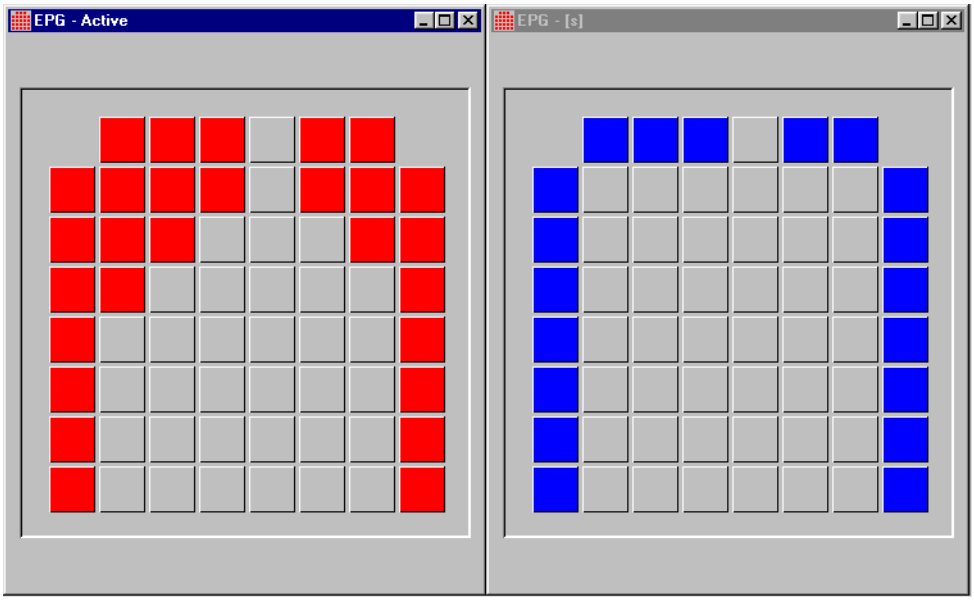
If you wish to add a model contact pattern, for the patient to mimic, press the “Open EPG Model” button on the toolbar.

An “Open” dialog box will appear, listing all available models.



Select the required model and click “Open”. Finally, click the “Auto Arrange” button on the toolbar.

The active EPG (red) and model (blue) will appear side by side, on the screen.



Dual channel Linguagraph

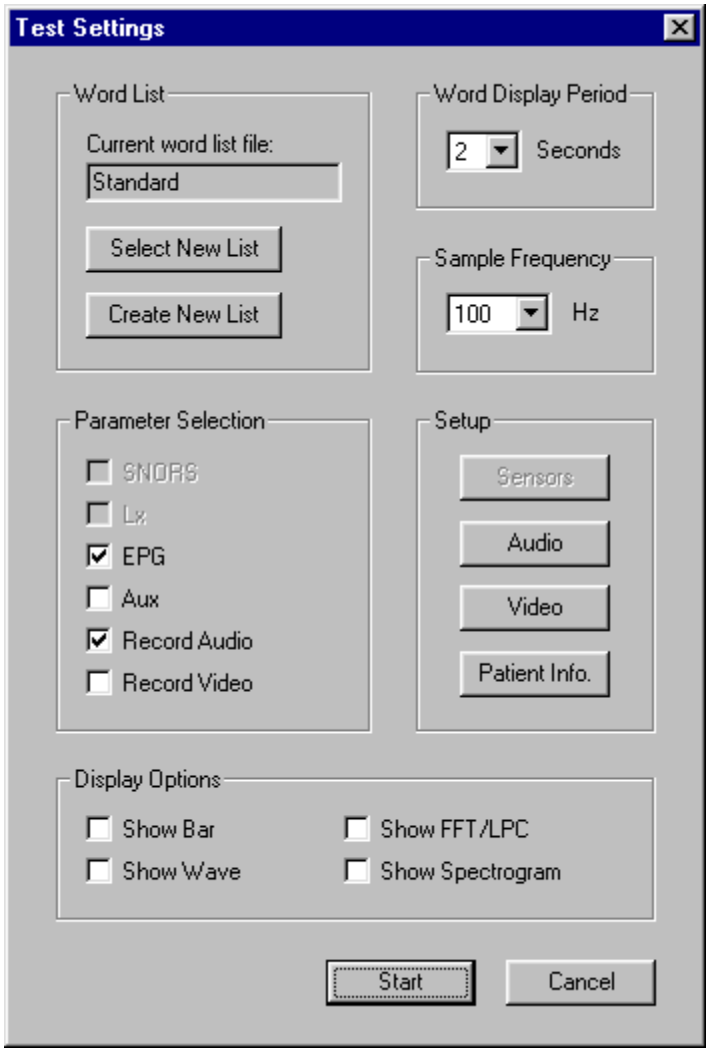
SNORS+ allows the simultaneous use of two Linguagraph units for dual channel operation. See Chapter 7 – Multiparameter use, for details.

Assessment

Test

To perform an assessment test, click “New Test” on the toolbar.

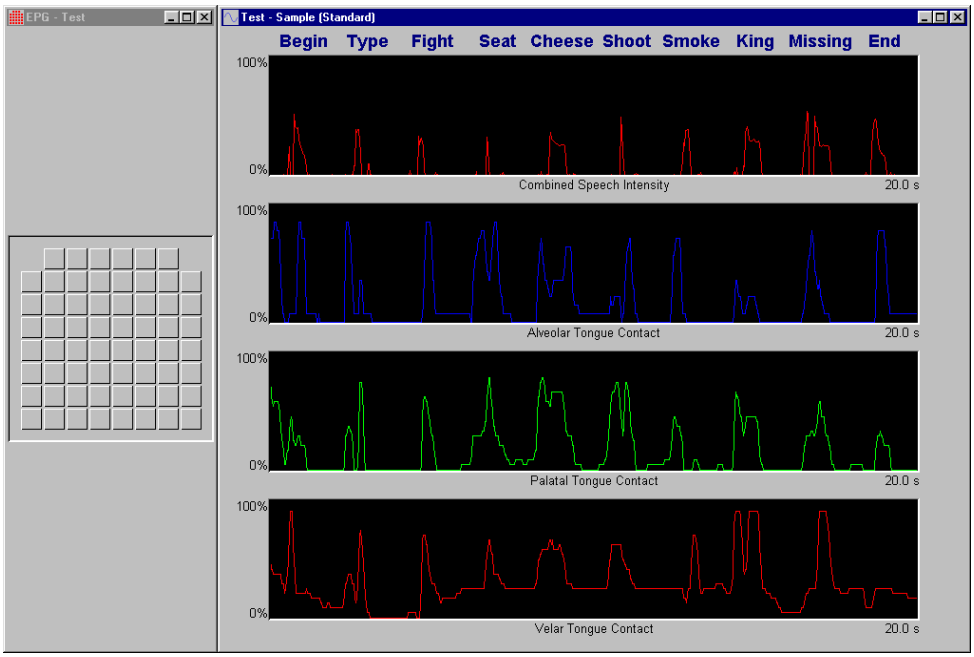
The “Test Settings” dialog box opens.



When you are ready to commence the test, click “Start” in the “Test Settings” dialog box.

After a short delay, a sequence of words appears on the screen. By default, the sequence is “Begin, Type, Fight, Seat, Cheese, Shoot, Smoke, King, Missing, End”.

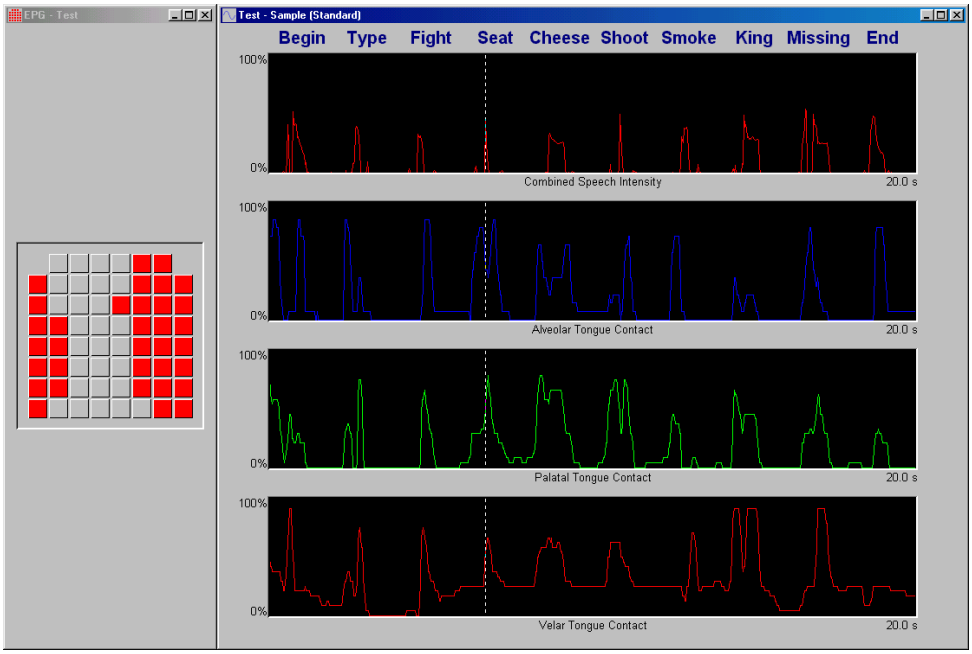
The patient is simply required to speak the words. At the end of the test, a Test display appears on the screen, showing the Speech Intensity waveform for the complete word list. To the left of the Test window, an EPG window can be seen. The EPG display will be blank, at this stage.



The sensitivity of the trace can be changed, if required, by pressing the **+** or **–** key on the **numeric keypad**. This is useful if the patient has spoken very quietly, for example, and the initial traces are low in amplitude. As the sensitivity is varied, the scales at the left of the screen alter to reflect the changes.

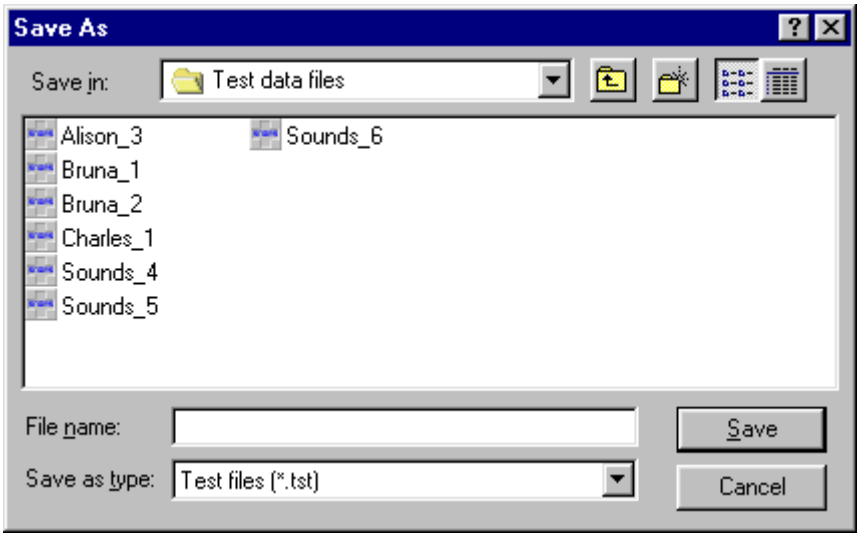
To listen to the recorded test, click “Play” on the toolbar.

The recorded sound is replayed and an animation cursor moves along the Test waveforms, in synchronism with the sound. The image in the EPG widow changes to reflect the tongue-palate contact pattern at the current cursor position.



To save the test results click “Save” on the toolbar.

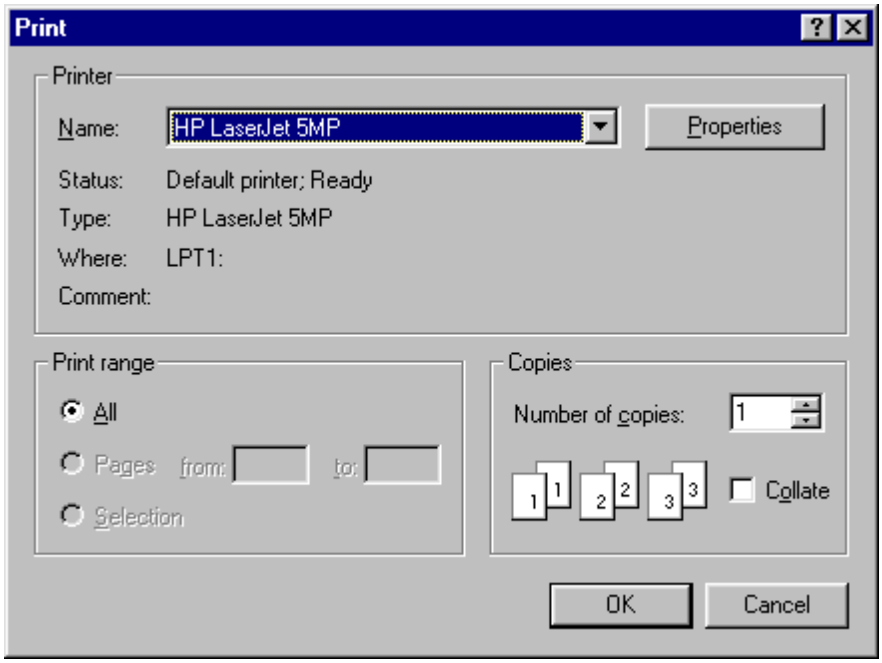
The “Save As” dialog box appears.



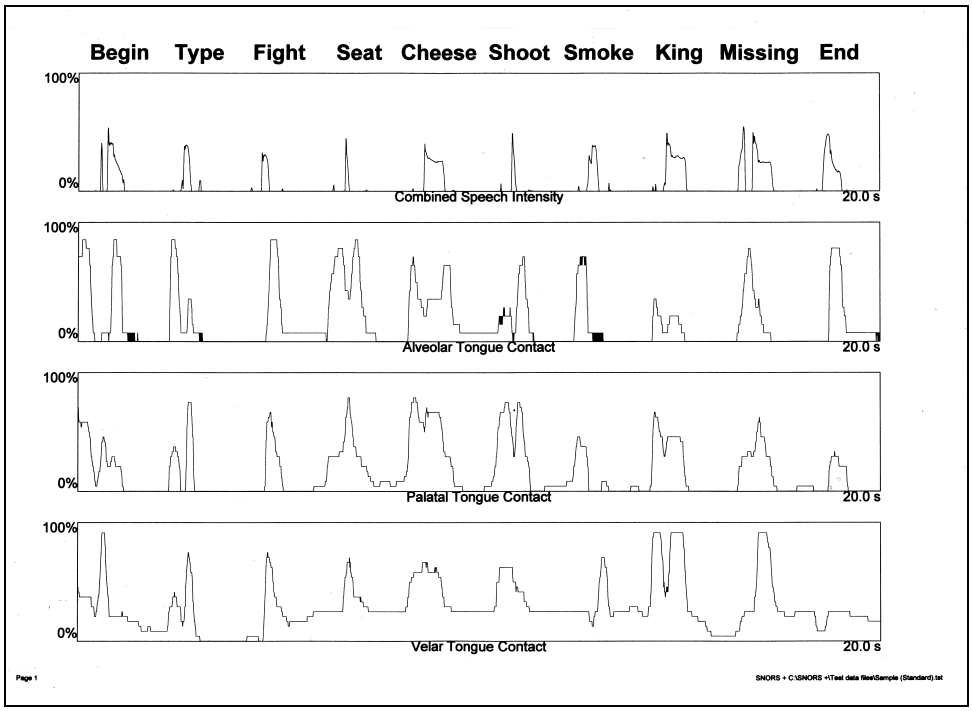
Type in a file name of your choice and then click “Save”.

To print the test, click “Print” on the toolbar.

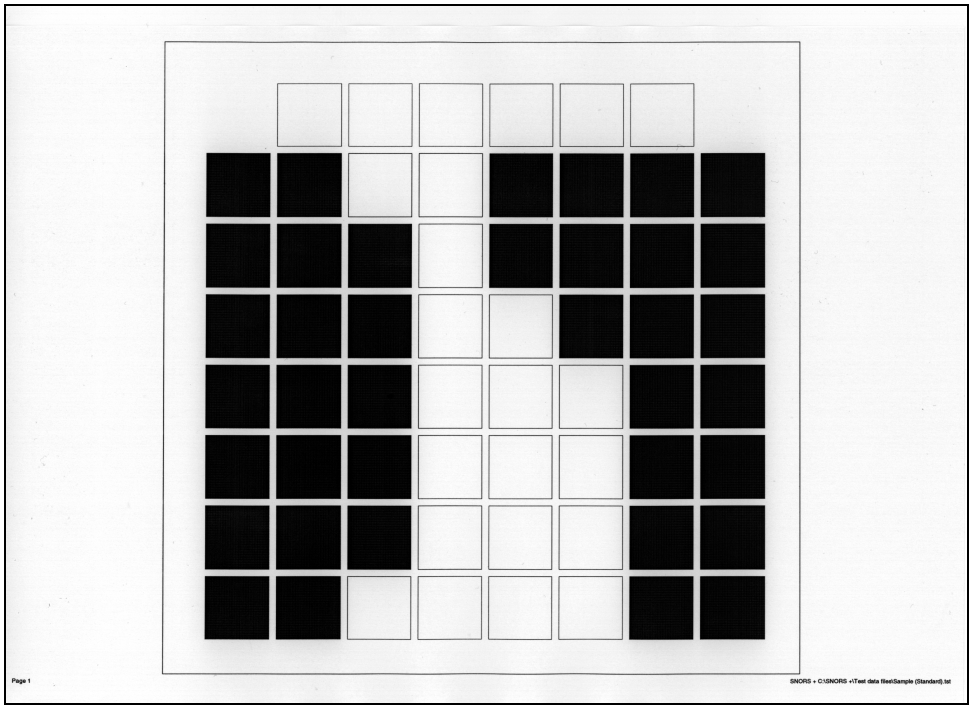
When the “Print” dialog box appears, click “OK”. [Note that the print dialog box is part of Windows 95/98® and will vary in appearance and function, according to your printer.]



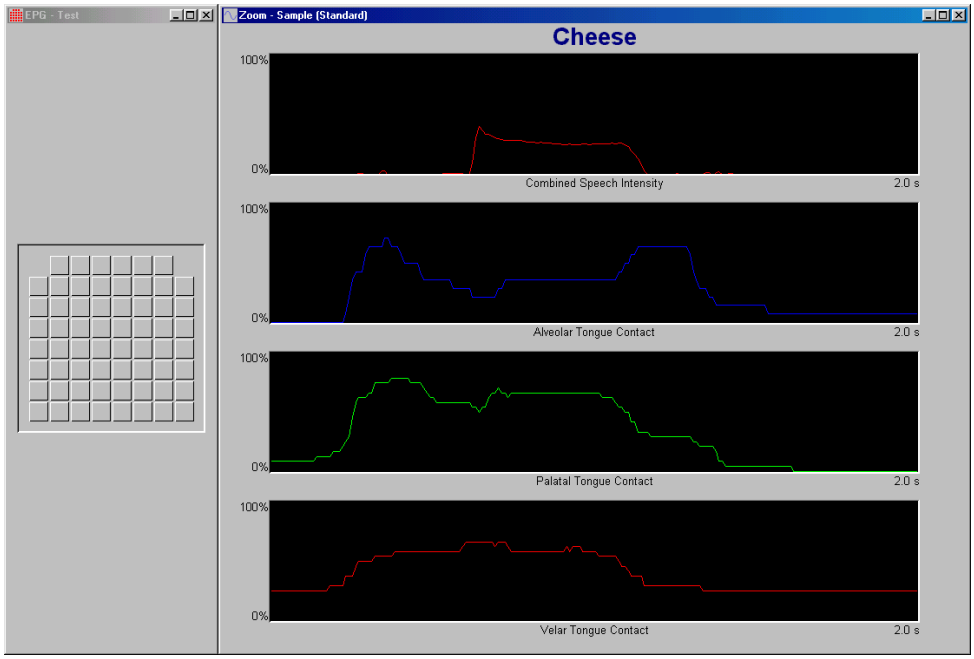
When you click “OK” a simple graphical printout of the active window will be produced. By default, this will be the Test screen.



To print the EPG window, click within it, so that its title bar is highlighted, click print, and proceed as before



To view a particular word in more detail, double click the screen, anywhere within the region of the chosen word (on either the text or the trace). A new window opens, showing just this word.

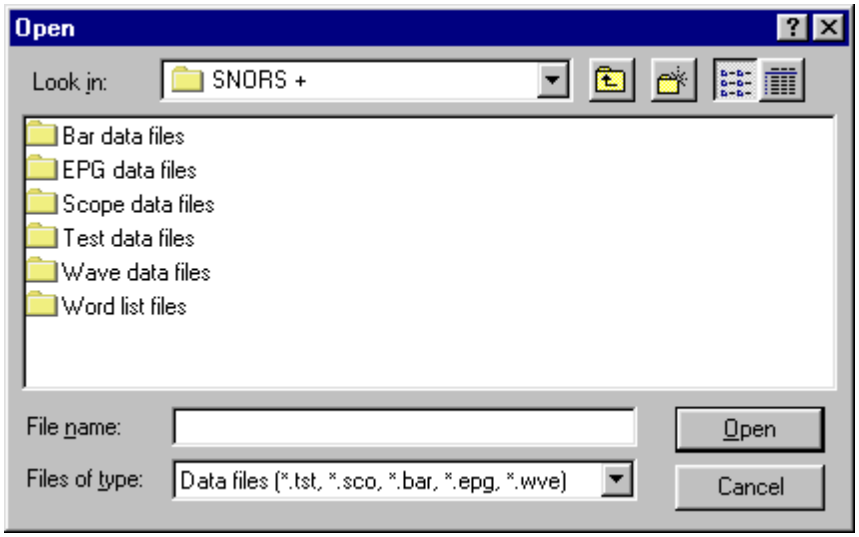


To close the test window, click on the “Close All” button, on the toolbar.

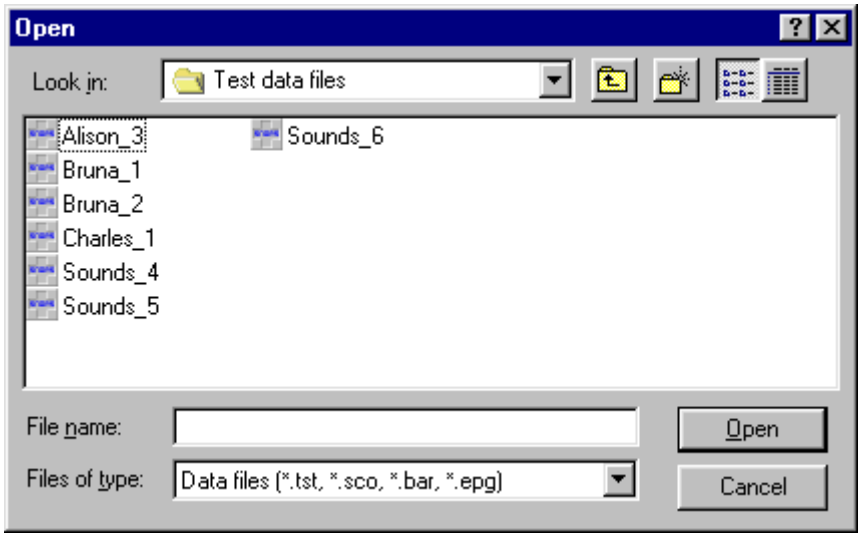
Open

To open a previously saved test file, click “Open” on the toolbar.

In the dialog box that appears, double click on the “Test data files” folder.



This will open the folder containing previous SNORS+ tests.



Next, click on the file that you wish to open and then click "Open". A Test display for the chosen test appears on the screen. This is exactly the same as a test window appearing at the end of an assessment test (see above).

When you have finished using SNORS+, close the program by clicking on its "Close" box, in the top right-hand corner of the display.

Chapter

5

Getting started – Laryngograph®

How to start using Laryngograph®

This chapter provides a quick introduction to using SNORS+ as a stand-alone, Laryngograph®-only system.

Connecting the hardware

Before using SNORS+, it is necessary to connect the hardware together. Basic setup should have been carried out at installation, but the hardware may have been subsequently disconnected, e.g. for transportation. If the hardware is not already correctly configured, proceed as follows.

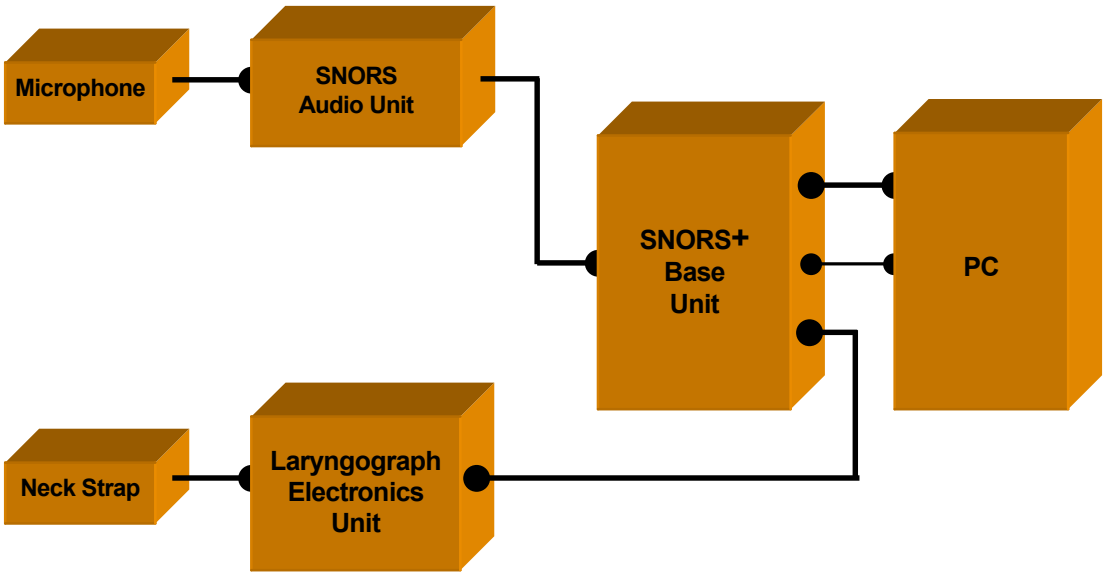
1) Make sure that the computer is switched off and disconnected from the mains.

2) Connect the SNORS+ Base Unit (large connector at rear) to the interface card installed in the computer, using the Data Cable. This is the thick cable with a large, flatish plug on each end. Note that the connectors are shaped and will only fit one way round in their sockets. Both ends of the cable are identical, however, so it does not matter which end is connected to which item.

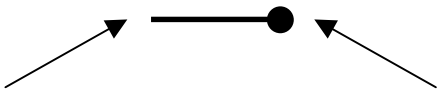
3) Connect the Laryngograph® Aux output to the SNORS Base Unit Lx input, using the cable provided.

4) Plug the SNORS Audio Unit lead into the appropriate connector on the front of the SNORS+ Base Unit (labelled Mask/Mic.). Look at the connectors, before mating them and align the red mark on the plug with the corresponding red mark on the socket. Gently push the two appropriate connectors together and rotate the plug, if necessary, until the two start to move together. When this occurs, you can push the two fully together. Plug the microphone into the connector at the front of the SNORS Audio Unit.

5) Connect the SNORS+ Base Unit's audio output to the PC Sound Card's "Line In" socket, using the Audio Cable provided. This is the lead with a small. 3.5 mm mini-jack plug on each end. It does not matter which way round the lead is.



Key to cabling:



Cable coming directly from unit Connector

6) Now plug in and switch on the computer. Once it has booted (this may take a few minutes) the system is ready to use.

Setting up

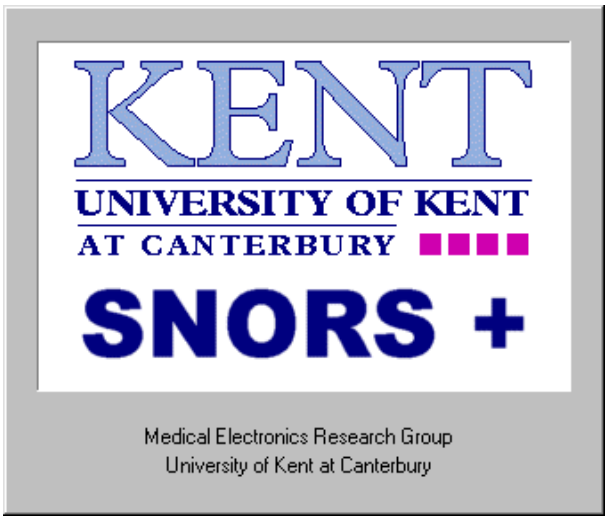
This section describes how to start up SNORS+ and check for correct operation. It is recommended that this simple procedure be carried out at the start of each session (i.e. with each new patient).

This is important for the following reasons:

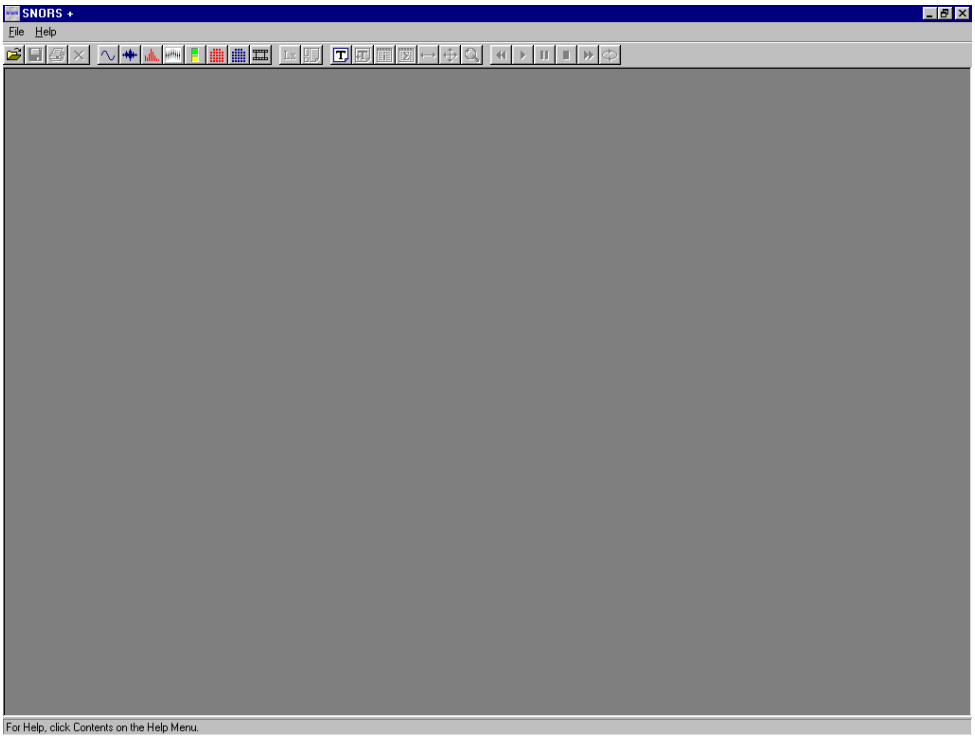
- It allows the patient to get used to speaking wearing the neck strap.
- It allows the therapist to check that the electrodes on the neck strap are correctly fitted and to adjust the sensitivity control to suit each patient.
- It allows the volume control to be set to the correct value for each particular patient.
- It allows the operation of the system to be discussed with the patient.

Open the SNORS+ program by double clicking on its icon.

A title screen appears briefly.



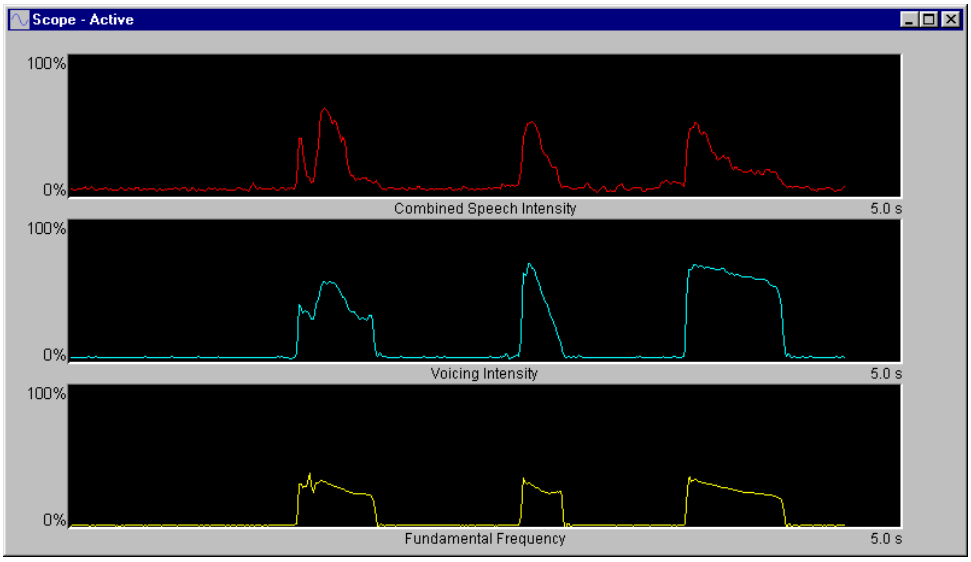
The main SNORS+ window then opens.



Note that many of the buttons are "Greyed out". This is because they are not available yet. In general, an option is greyed out whenever it is not available. This may be because the option is not relevant at the time, or it may be because the necessary hardware (e.g. a sound or video card) is not present.

Start a scope display by clicking on the "New Scope" button on the toolbar.

A scope window appears.



Switch on the Laryngograph® unit. Place the Laryngograph® electrode strap around the patient's neck, so that the electrodes sit comfortably either side of the thyroid cartilage.

Place the microphone a suitable distance from the patient's mouth. In most cases, clipping it to a tie or jumper, is satisfactory.

Ask the patient to speak and watch the traces on the screen (see above). Adjust the volume control on the SNORS hardware unit (The black knob on the front of the unit) until the red "Combined Speech Intensity" trace deflects by a good amount, but does not quite reach the top of its window (as shown in the example above). Then adjust the sensitivity control on the Laryngograph® unit (The blue knob on the front of the unit, at the right) until the blue "Voicing Intensity" deflects by a good amount, but does not quite reach the top of its window (as shown in the example above).

When you are happy with the operation of the system, click the "Close All" button, on the toolbar.

The system is now ready to use.

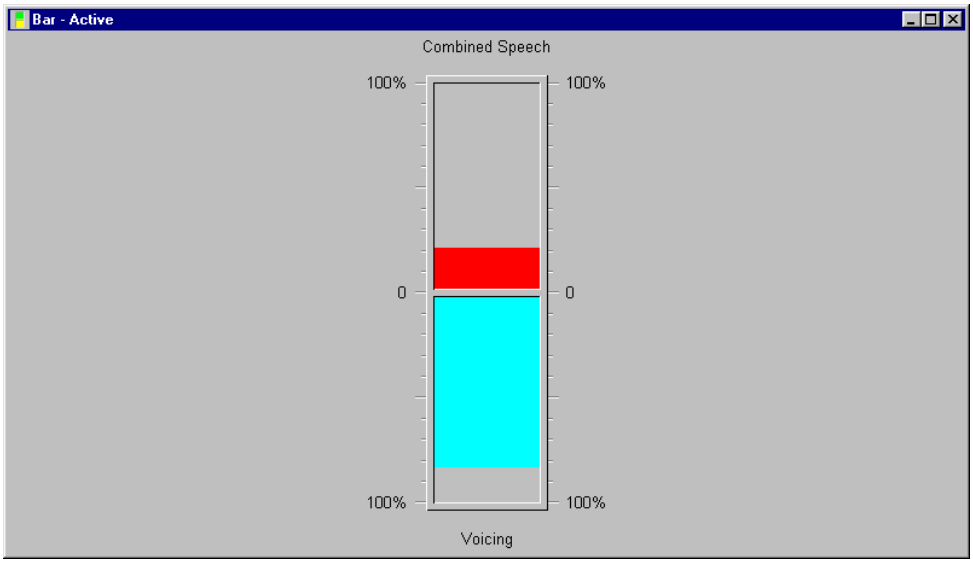
Therapy

Bar

To open the therapy Laryngograph® window, click on the "New Bar" button on the toolbar.

A Laryngograph® Bar window will open.

The bar can be enlarged to fill the SNORS+ window by clicking the "Auto Arrange" button, on the toolbar.



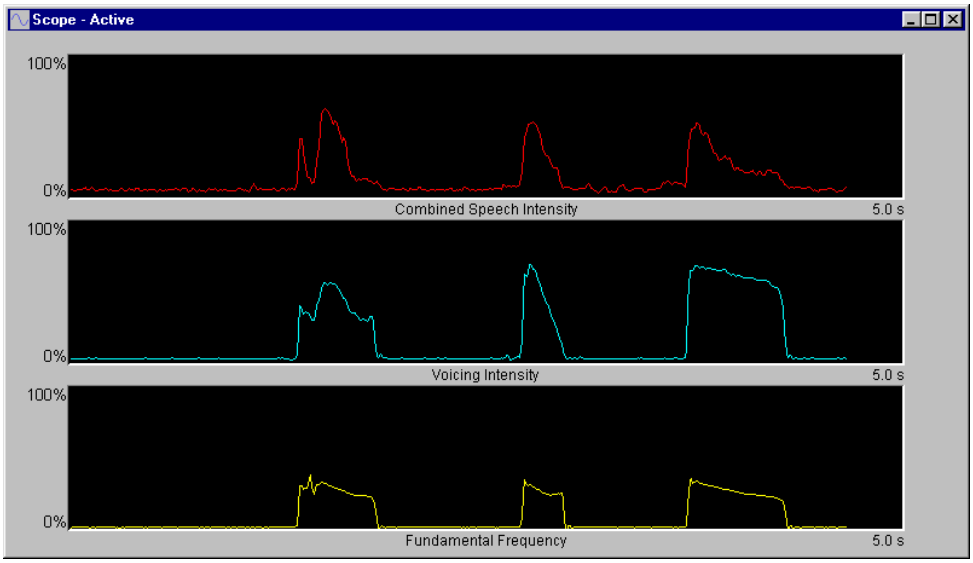
The upper section of the display shows the intensity of the speech sound, as a red bar, which moves upwards away from the centre. The lower section indicates the voicing intensity as a cyan bar, which moves downwards away from the centre.

Bar is a very useful biofeedback tool, as it provides a simple, clear display of speech and voicing intensities This allows patients to monitor their voicing, make corrections, and observe the result. Bar is particularly useful when working with sustained sounds or single phonemes.

Scope

To use Laryngograph® in Scope mode, click the "New Scope" and "Auto Arrange" buttons on the toolbar.

A Scope window opens with three traces – Speech Intensity, Voicing Intensity and Fundamental Frequency.



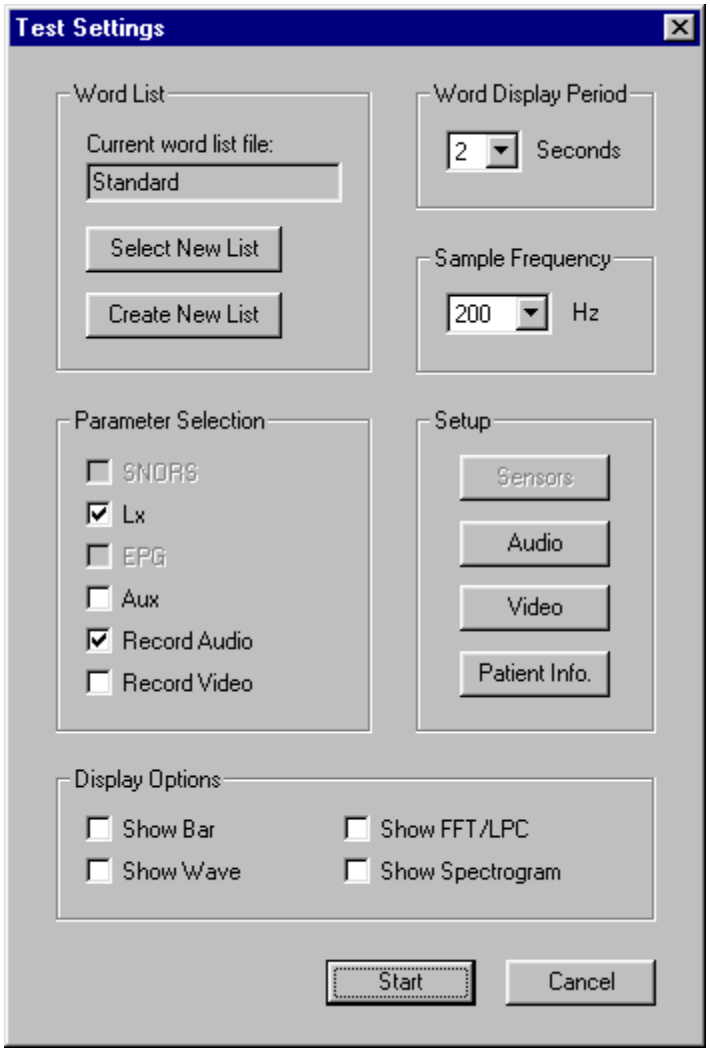
Scope is also useful in therapy as it allows patients to observe the dynamics of their speech. Thus, it is useful when working with clusters or words.

Assessment

Test

To perform an assessment test, click “New Test” on the toolbar.

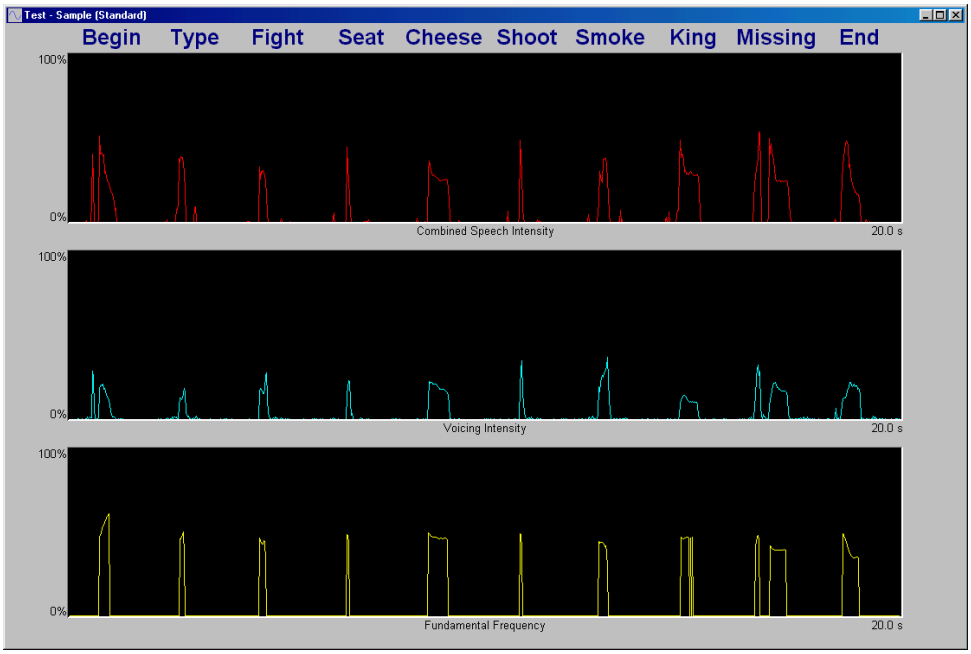
The “Test Settings” dialog box opens.



When you are ready to commence the test, click “Start” in the “Test Settings” dialog box.

After a short delay, a sequence of words appears on the screen. By default, the sequence is “Begin, Type, Fight, Seat, Cheese, Shoot, Smoke, King, Missing, End”.

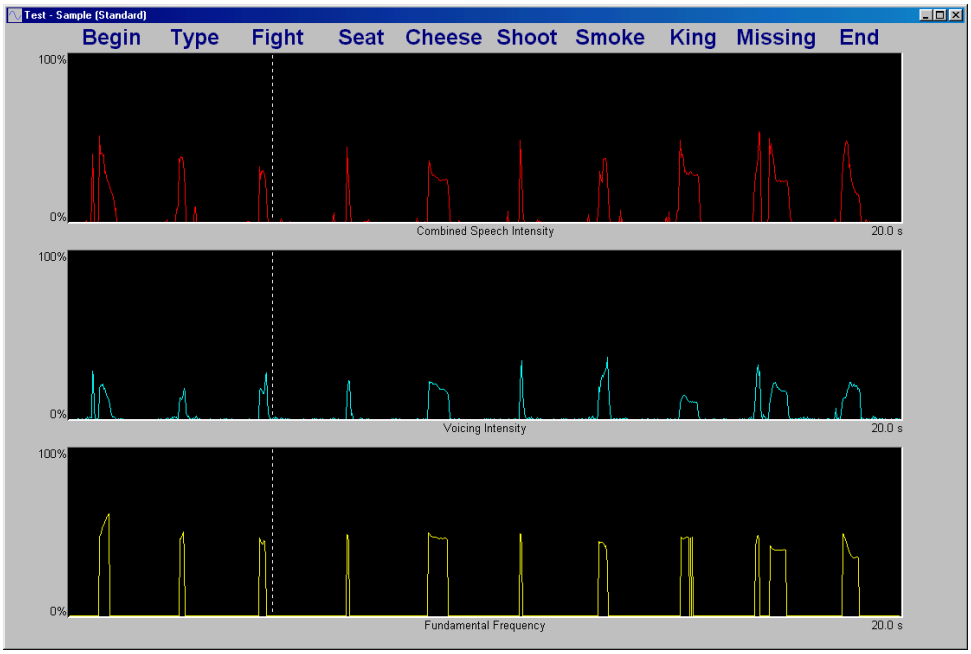
The patient is simply required to speak the words. At the end of the test, a Test display appears on the screen, showing the Speech Intensity, Voicing Intensity and Fundamental Frequency waveforms for the complete word list.



The sensitivity of the traces can be changed, if required, by pressing the **+** or **–** key on the **numeric keypad**. This is useful if the patient has spoken very quietly, for example, and the initial traces are low in amplitude. As the sensitivity is varied, the scales at the left of the screen alter to reflect the changes.

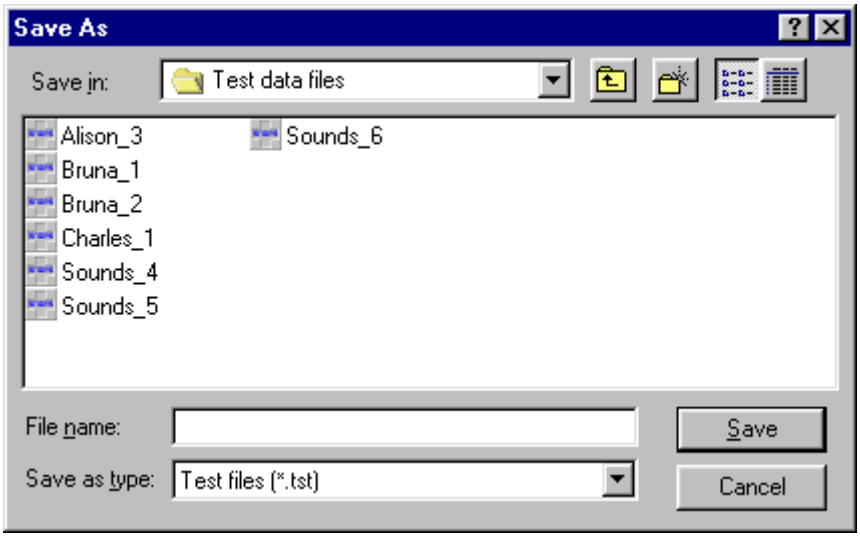
To listen to the recorded test, click “Play” on the toolbar.

The recorded sound is replayed and an animation cursor moves along the Test waveforms, in synchronism with the sound.



To save the test results click “Save” on the toolbar.

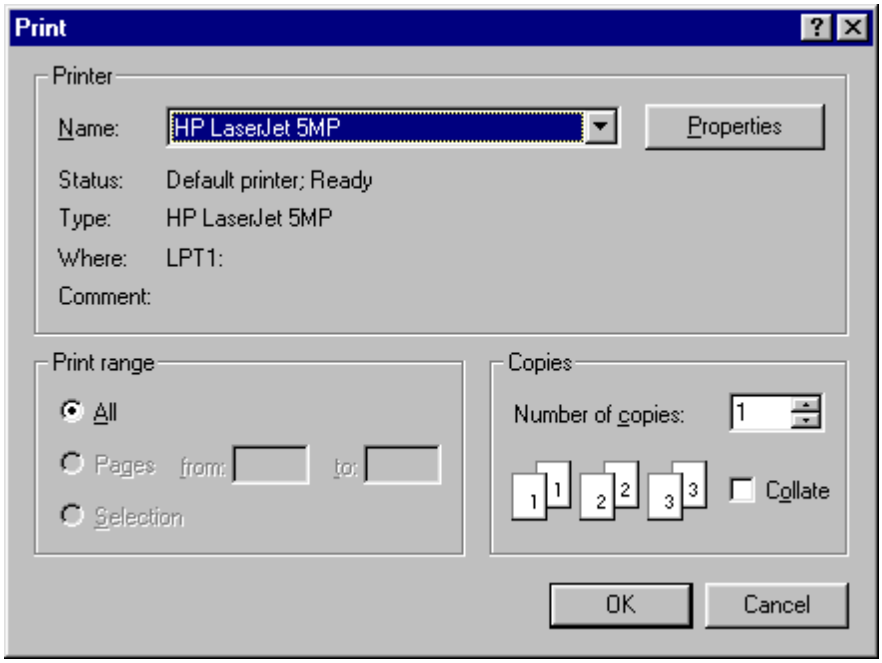
The “Save As” dialog box appears.



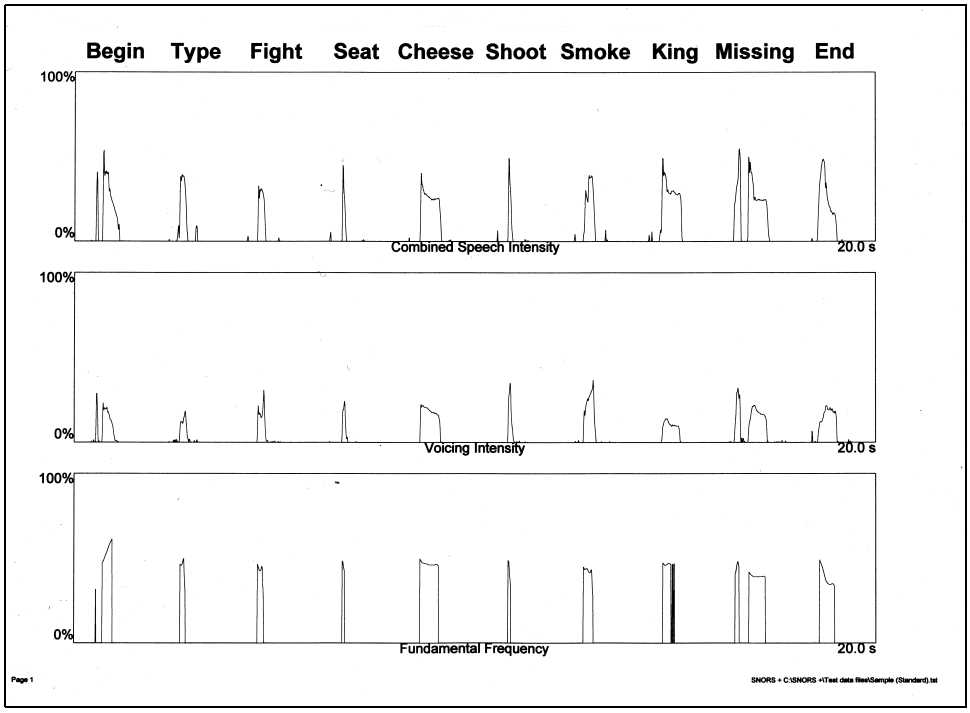
Type in a file name of your choice and then click “Save”.

To print the test, click “Print” on the toolbar.

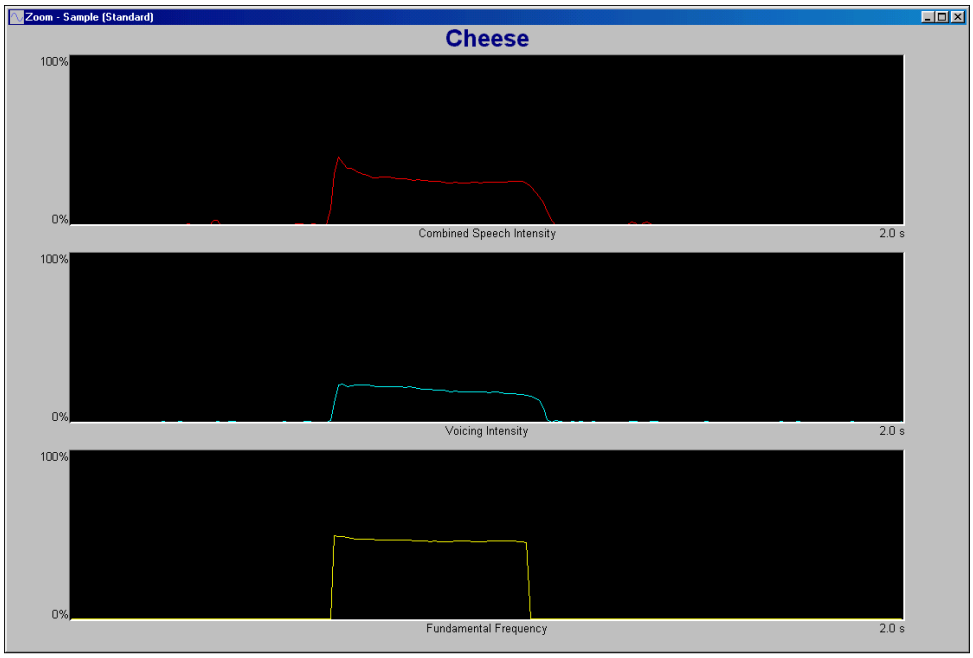
When the “Print” dialog box appears, click “OK”. [Note that the print dialog box is part of Windows 95/98® and will vary in appearance and function, according to your printer.]



When you click “OK” a simple graphical printout of the Test screen will be produced.



To view a particular word in more detail, double click the screen, anywhere within the region of the chosen word (on either the text or the trace). A new window opens, showing just this word.

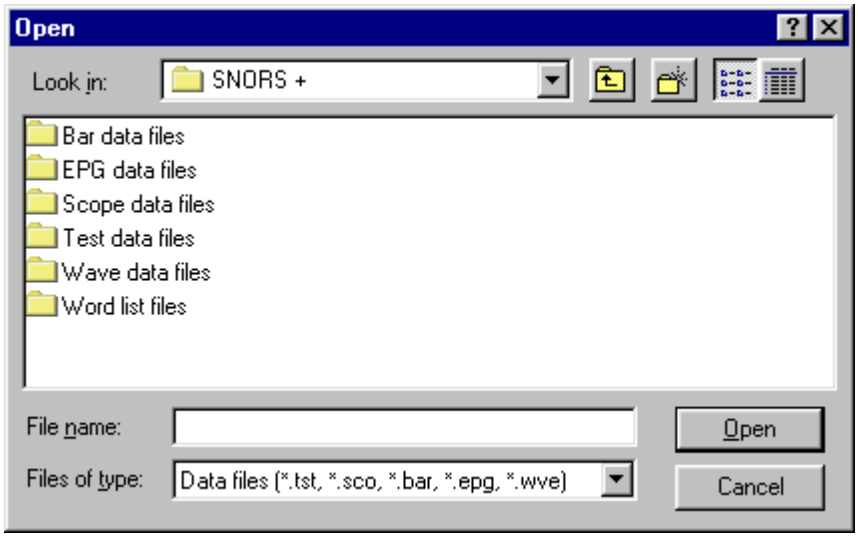


To close the test window, click on the “Close All” button, on the toolbar.

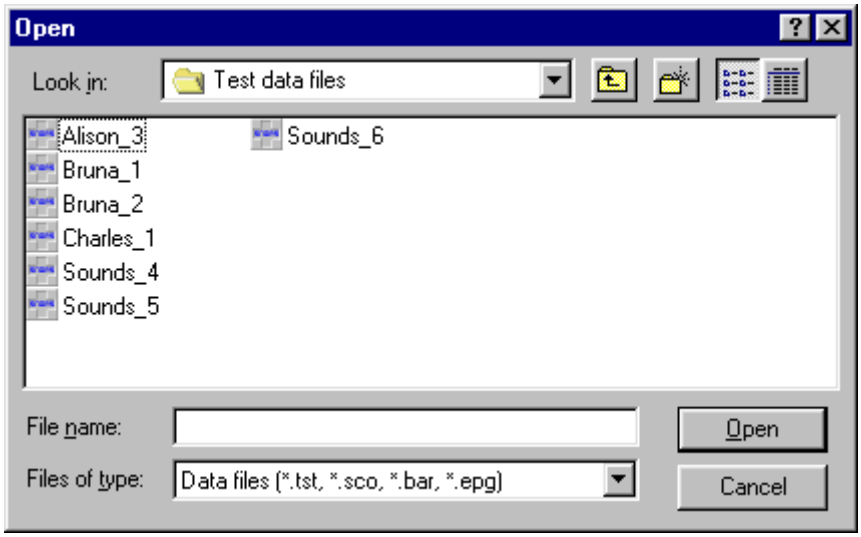
Open

To open a previously saved test file, click “Open” on the toolbar.

In the dialog box that appears, double click on the “Test data files” folder.



This will open the folder containing previous SNORS+ tests.



Next, click on the file that you wish to open and then click "Open". A Test display for the chosen test appears on the screen. This is the same as a test window appearing at the end of an assessment test (see above).

When you have finished using SNORS+, close the program by clicking on its "Close" box, in the top right-hand corner of the display.

Chapter
6

The next steps

Getting more out of SNORS+

This chapter explains how to use all of the remaining basic features of SNORS+, in single-parameter mode. For many users, this may be all that is ever required.

Measurement of Outcome

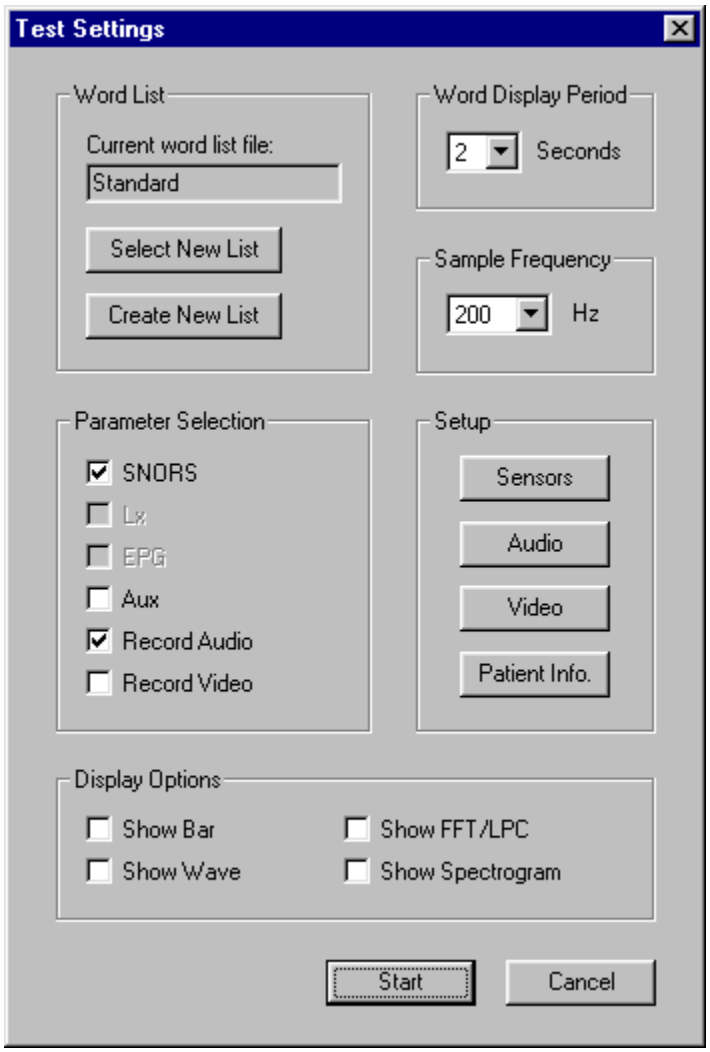
The assessment test, described in the previous three Chapters, provides a graphical representation of the speech mechanics, along with the resulting sound. SNORS records nasal and oral airflows, from which the action of the velum can be inferred and an assessment of function can be made. Linguagraph records tongue-palate contact directly and Laryngograph® provides a similarly direct picture of vocal fold vibration. Although these data are objective, they are also qualitative.

In order to measure outcome, quantitative data is required. It is also useful to record more than one test (to assess intra-subject variability), to use alternative word lists, and to store patient information. This Chapter describes how to add these features to an assessment test and to carry out quantitative analysis. For clarity, this chapter refers solely to SNORS, but the techniques described are equally applicable to Linguagraph and Laryngograph® (with the exception of sensor "Setup" and the definitions of "Nasalance" and "Ratio").

Test

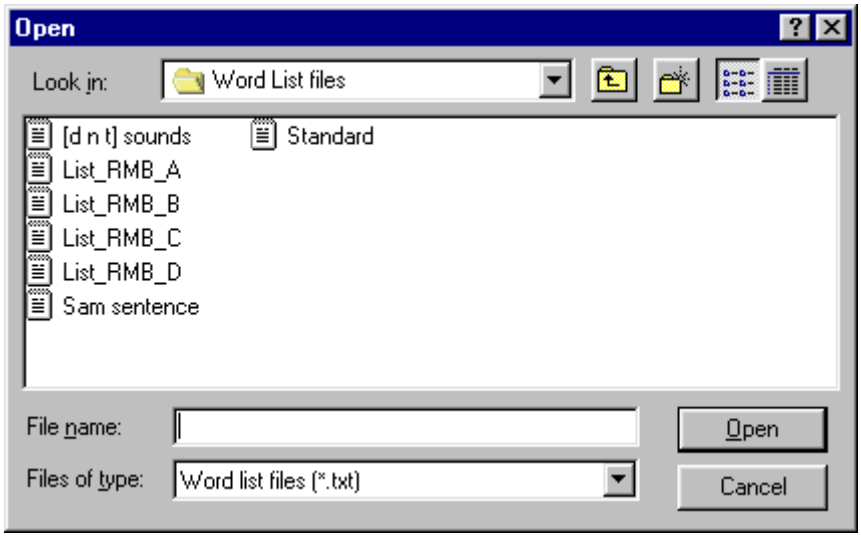
Perform an assessment test (as in, e.g., Chapter 3) by clicking "New Test" on the toolbar.

The "Test Settings" dialog box opens. It is now possible to make choices about the test parameters and/or enter details of the patient to be tested.



Word list

By default, SNORS uses the "Standard" word list, as indicated in the "Current word list file:" box. An alternative word list can be selected by clicking the "Select New List" button. This opens the Windows 95/98® "Open" dialog box, which displays all the available word list files.



A word list is selected by clicking on it and then clicking "Open".

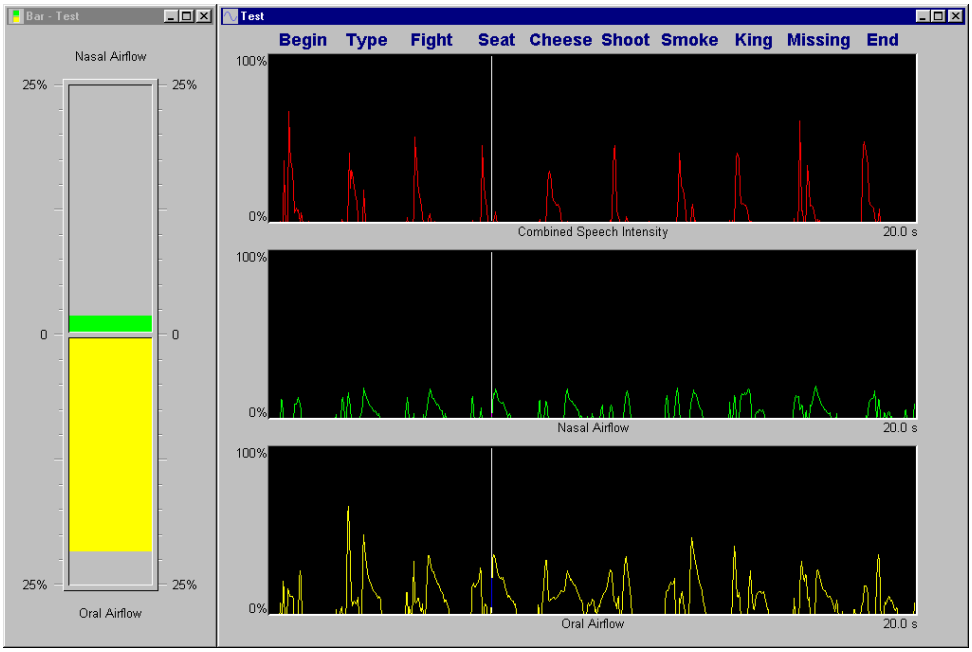
It is also possible to create your own word lists by clicking the "Create New List" button. This is described in Chapter 12.

Parameter Selection

The "Parameter Selection" of the "Test Settings" dialog box is used when multiparameter testing is required. This is described in Chapter 7.

Display Options

Display options allow the user to choose to automatically display an extra window at the end of the test. If the "Show Bar" check box is clicked, a Bar window appears, alongside the normal (Scope) test window.



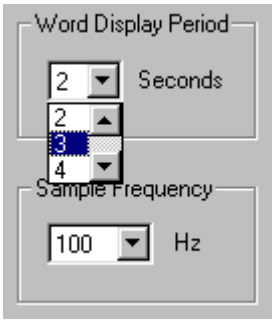
If a cursor is active (Track Cursor shown above) Bar displays the values at the cursor position. These are the instantaneous values, for a track cursor, or the average values[2], for a block cursor. If audio is replayed, the Bar display changes continuously to reflect the current (moving) animation cursor position.

Clicking "Show Wave" instead of "Show Bar" results in a Wave window appearing alongside Scope, at the end of the test. See the "Wave – Viewing high resolution waveforms" section, at the end of this Chapter, for details of Wave windows.

Word display period

The time for which each word is displayed on the screen (and hence the time allowed for the patient to utter the word) can be varied by clicking the symbol at the right of the "Word Display Period" box and selecting the required time (between 1 and 10 seconds) from the drop-down box that appears.

[2] Values are averaged over the time period contained within the block cursor.



The new ▲ and ▼ that appear, in the drop-down box, can be used to move up and down through the available range (from 1 to 10 seconds, in one second steps, and from 10 to 90 seconds, in ten second steps).

The "Sample Frequency" can be changed by clicking on its ▼ symbol. This is described in Chapter 12.

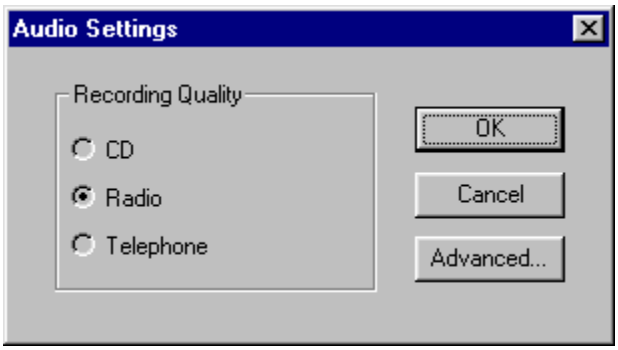
Setup

Sensors

Clicking the "Sensors" button allows the flow sensors to be initialised. As this function is called automatically at the start of each session, it should not normally be necessary to use this button. In a particularly long session, however, it is a good idea to initialise the sensors occasionally (about once an hour).

Audio

The "Audio" button allows selection of the audio quality (sound card sampling rate).



The default quality (Radio) uses a sampling rate of 22 kHz, which should be satisfactory for most purposes. If required, the audio can be increased to CD quality (44 kHz), or reduced to Telephone quality (11 kHz). It should be noted, however, that the higher the quality, the larger the file's size! A standard test **without sound** requires just 23 Kbytes of disk space. The same test with "Telephone", "Radio" or "CD" quality sound occupies about 900 Kbytes, 1.8 Mbytes or 3.5 Mbytes, respectively.

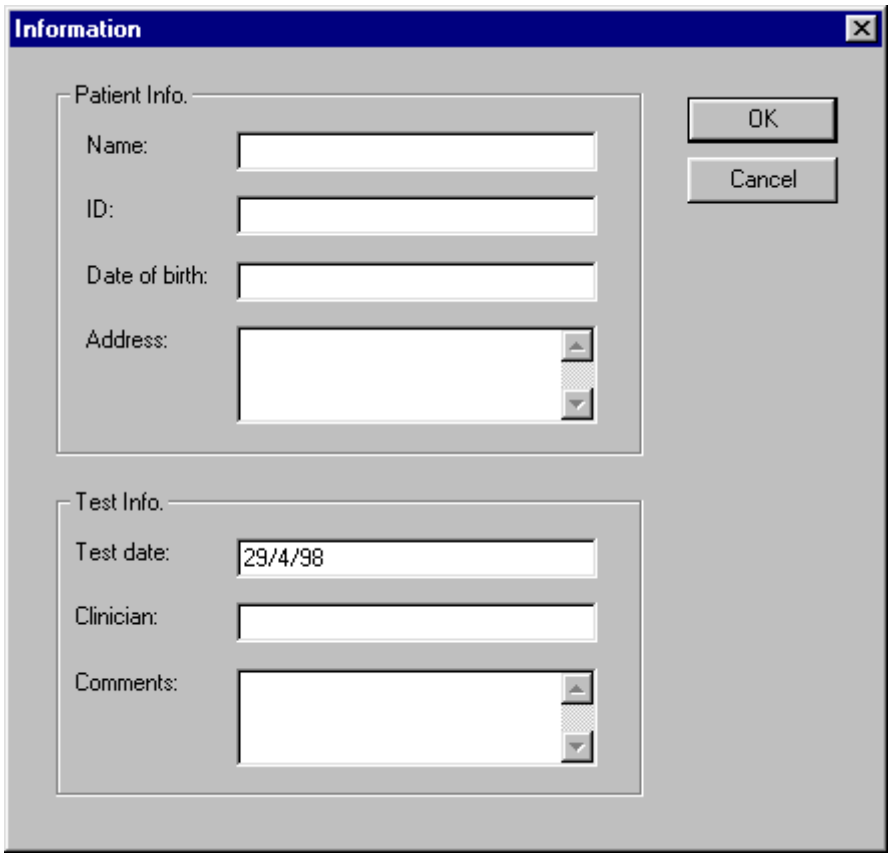
The "Advanced" audio settings are described in Chapter 12.

Video

The "Video" button permits setting of video capture parameters. These are described in the "Adding video" section, at the end of Chapter 7.

Patient Info.

Clicking the “Patient Info.” button allows details of the patient being tested to be entered and stored with the test results. A new dialog box appears, for data entry.



Simply use the mouse to click in a box where it is desired to enter information and type in the details. It is not necessary to enter information in all the boxes – just use those that you require. The “Test date” is automatically entered, but can be changed if required.

When all required selections have been made, they can be implemented by clicking “OK” or rejected by clicking “Cancel”.

Start

Clicking the “Start” button initiates the test, using the current settings.

Cancel

If it is decided not to proceed with the test, clicking “Cancel” will close the “Test Settings” dialog box without proceeding with the test.

Repeat test

If you wish to make a second test on the same patient, click on the “Repeat Test” button on the toolbar.

This is the same as clicking “Test” except that all test data will remain in place. This includes word list, display period, sample frequency, parameter selection and all

patient details[3] in the “Information” dialog box. This saves having to re-enter the data. It is easy to edit the data to make small changes that may be necessary, e.g. to the comments.

Analysis

Analysis can be carried out either immediately after completing a test, or by opening a previously saved test.

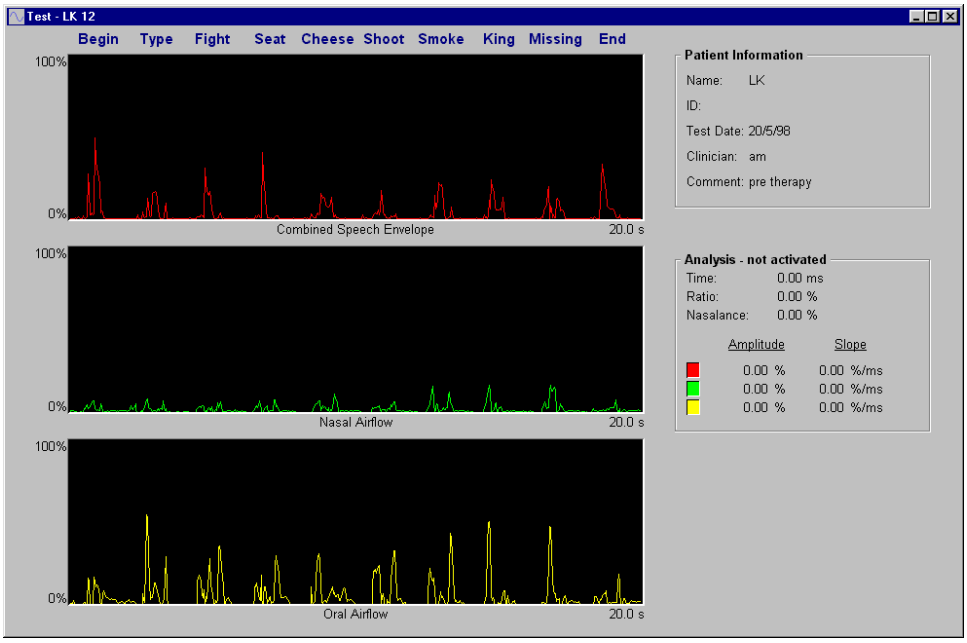
Show Analysis

The analysis box shows the results of measurements made on the test data[4]. To open the analysis box, click the “Show Analysis” button on the toolbar.

Show Patient Info.

When making an analysis and printing the results, it is often useful to include patient information on the printout. Clicking the "Show Patient Info." button on the toolbar opens the patient information box.

A test window, with patient Information and analysis boxes, is shown below.



Show Track Cursor

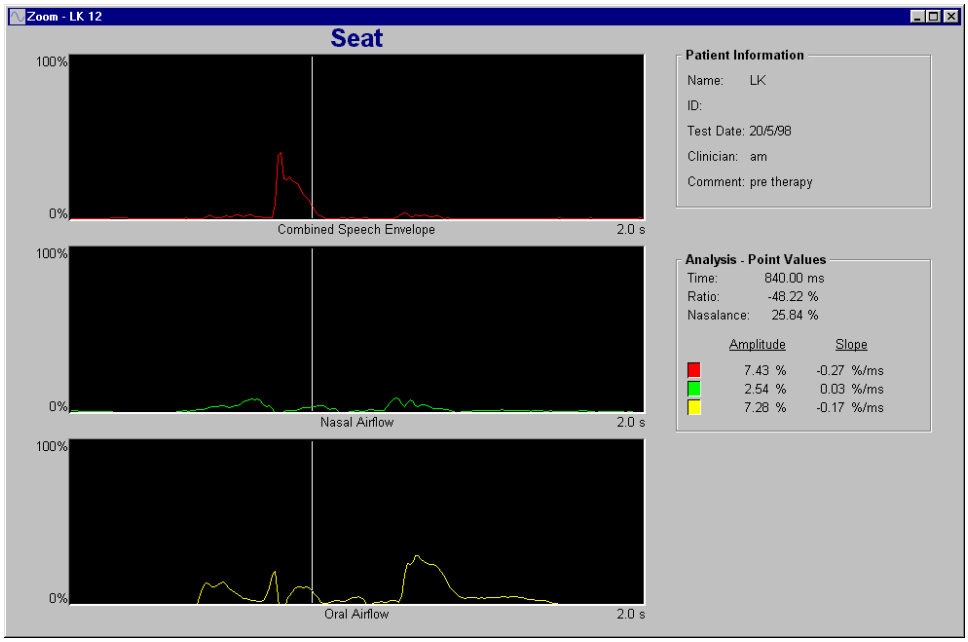
The track cursor, which is enabled by clicking the “Show Track Cursor” button on the toolbar, allows point measurements to be made.

The Analysis box heading changes to “Analysis – Point Values”, when this cursor is active. The cursor can be moved by placing the mouse pointer over the cursor line and then clicking and dragging the cursor to the required position. Values of all trace

[3] The date will be updated automatically, if appropriate.
[4] Time, Nasalance and Ratio values also appear on the Status Bar, so it is not necessary to select “Show Analysis” simply to measure nasalance, for example. However, other values, such as “Slope”, only appear in the Analysis box. Also, the status bar does not appear when the results are printed.

amplitudes and slopes appear in the analysis box, along with values for “Nasalance” and “Ratio” (see definitions below). If audio playback is activated when a track cursor is selected, sound will be replayed from the cursor position to the end of the recording.

When the cursor is active, it is easier to make measurements when viewing a single word. This can be achieved by double clicking on the required word (either the text or the trace). When this is done, a new window opens, showing just the selected word. In this case, activating playback replays from the cursor to the end of the word.



Show Block Cursor

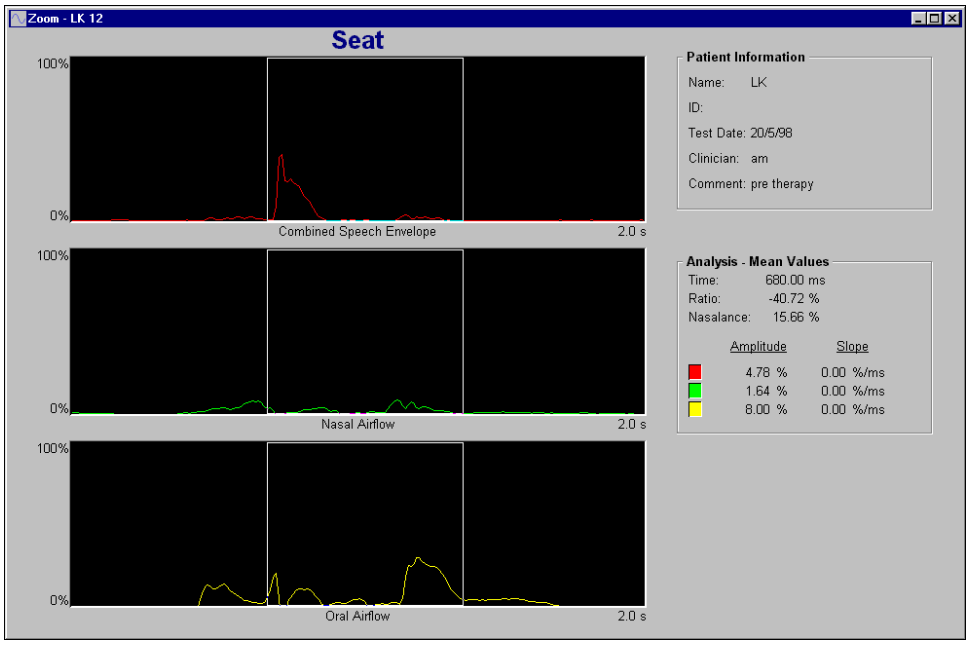
The block cursor, which is enabled by clicking the “Show Block Cursor” button on the toolbar, allows average measurements to be made.

The analysis box heading changes to “Analysis – Mean Values”, when this cursor is active. The cursor can be moved by placing the mouse pointer within the cursor box and then clicking and dragging the cursor to the required position.

The start and end of the block can be moved by placing the mouse pointer over the start or end line and then clicking and dragging the line to the required position. Values of mean values for all trace amplitudes and slopes appear in the analysis box, along with mean values for “Nasalance” and “Ratio” (see below).

As for the track cursor, when the cursor is active, it is easier to make measurements when viewing a single word. This can be achieved by double clicking on the required word (either the text or the trace). When this is done, a new window opens, showing just the selected word.

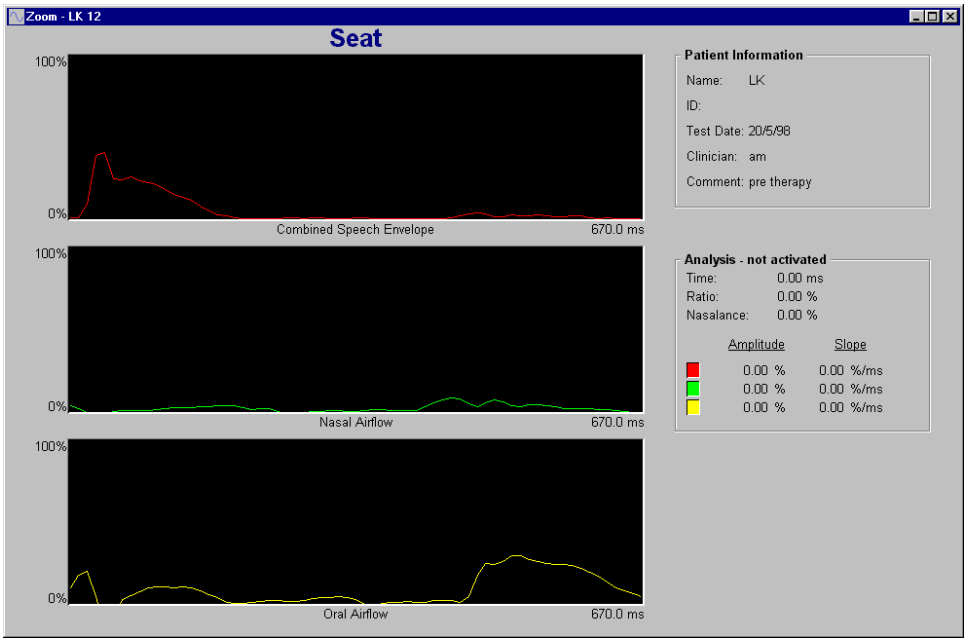
When a block cursor is active, playback replays just the section of the recording within the visible cursor block.



Zoom

The zoom function allows the user to zoom into a selected section of the waveform. This is activated by clicking on the “Zoom” button on the toolbar.

It is then a simple matter to click and drag the zoom cursor, to draw a box around the area to be zoomed. When the mouse button is released, a new window will open, showing just the selected area.



To return to the previous (unzoomed) view, simply close the active window, by clicking its “Close” box, at its top right-hand corner.

Notes on **terms** used in analysis

Nasalance

Unless otherwise stated, in SNORS+, "nasalance" is taken to mean **aerodynamic** nasalance. It should not be confused with acoustic nasalance that is measured by some other systems. [SNORS+ can also measure acoustic nasalance, with limited sensitivity.]

Nasalance is the percentage of the total positive **airflow** that is nasal.

The nasalance figure calculated by SNORS is based on either point values (track cursor) or the **total** airflow within the block cursor box. If this box contains elements of zero flow or respiration, these will be included in the calculation. Periods of zero flow will simply reduce the sensitivity of the calculation and will not introduce any specific errors. Hence, small periods of zero flow, within the zoom window, are quite acceptable. Periods of respiration, however, will **significantly** affect the nasalance calculation. Thus**, it is most important that they are excluded from the block cursor box**, unless it is required that their effect should be included.

The speech intensity channel is helpful in determining which parts of the flow waveform are due to speech and which are due to respiration – there should normally be very little sound during respiration. However, a little care should be exercised as breathing is sometimes audible and some sounds – such as sibilants – have a low acoustic level. But, with a little practice and knowledge of speech production, it should be fairly easy to select the appropriate sections of the waveform for use in nasalance calculations. For best results, use the block cursor to isolate the word and then listen to the audio playback to ensure that the correct portion has been selected.

Ratio

Ratio is the difference between nasal and oral airflow divided by the total airflow, expressed as a percentage.

The ratio figure calculated by SNORS is also based on either point values (track cursor) or the **total** airflow within the block cursor box. If this box contains elements of zero flow or respiration, these will again be included in the calculation, but their effect will be less significant. As for ratio, periods of zero flow will simply reduce the sensitivity of the calculation and will not introduce any specific errors. Hence, small periods of zero flow, within the zoom window, are quite acceptable. Although the effects of respiration are **reduced** in the ratio calculation**, it is still recommended that they are excluded from the block cursor box**, unless it is required that their effect should be included.

As for nasalance, the speech intensity channel is helpful in determining which parts of the flow waveform are due to speech and which are due to respiration – there should normally be very little sound during respiration. However, a little care should be exercised as breathing is sometimes audible and some sounds – such as sibilants – have a low acoustic level. But, with a little practice and knowledge of speech production, it should be fairly easy to select the appropriate sections of the waveform for use in ratio calculations.

Sound Waveform Features

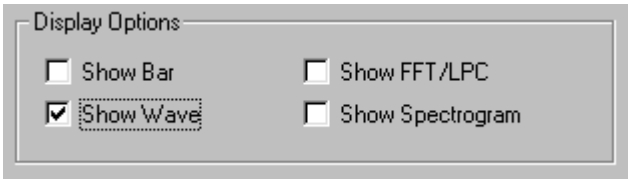
The audio recording facility provided by SNORS+ does far more than simply play back the sounds uttered by the patient. The detailed sound waveform can be viewed, at a range of magnifications, and the synchronous nature of the recording allows the user to listen to any selected portion of the test waveforms. The sound waveform can also be analysed, in the frequency domain, providing Fast Fourier Transform (FFT), Linear predictive Coding (LPC) and spectrogram displays.

Wave, FFT/LPC and Spectrogram displays can also be used in real-time, for therapy.

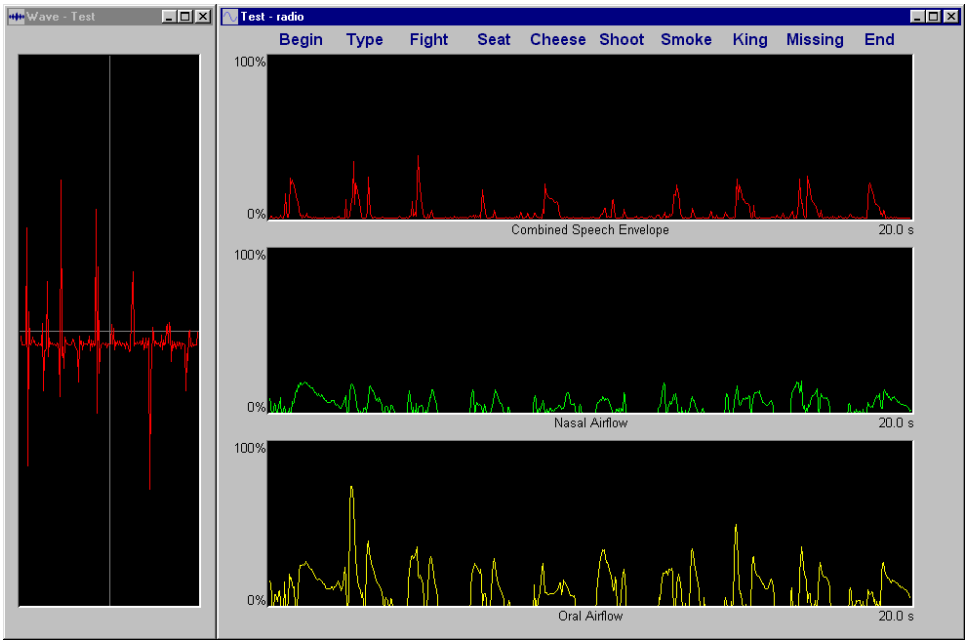
Wave – viewing high resolution waveforms

It is possible to view the high-resolution Speech (Sp) waveform, provided "Record Audio" was selected when the test was performed. [This is selected by default].

The easiest way to view the high-resolution waveform is to select "Show Wave" at the time of recording the test. This is achieved by clicking in the "Show Wave" check box, in the "Display Options" part of the "Test Settings" dialog box.



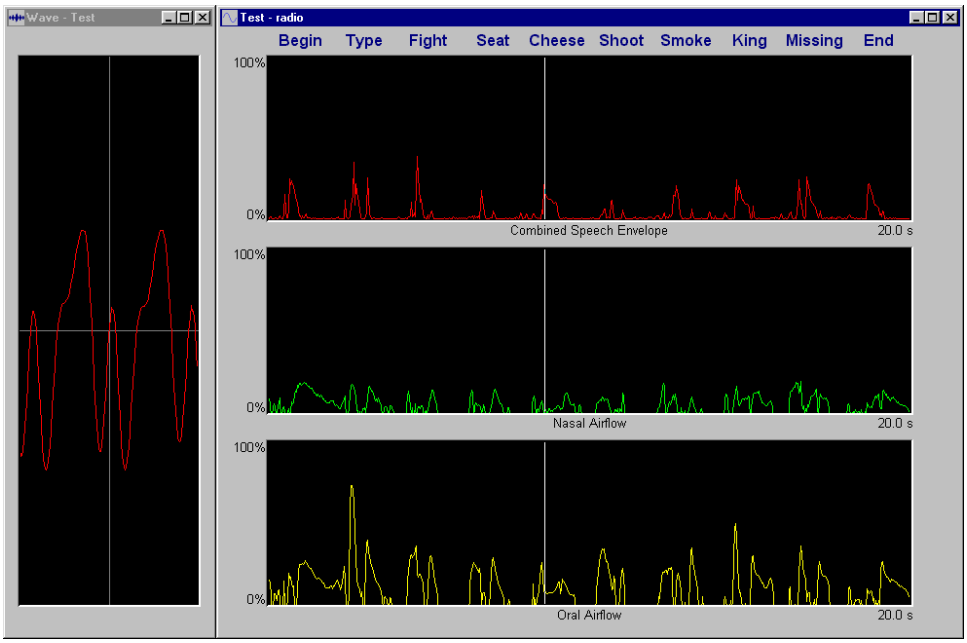
At the end of the test, the Wave window appears at the left of the display.



With no cursors on the screen, the Wave window displays the entire recording. Due to the limited screen resolution, it is not possible to see any detail in the waveforms, at this scale. To view detail, it is necessary to zoom into a portion of the waveform. This is achieved automatically by switching on a cursor.

Click on the "Show Track Cursor" button on the toolbar.

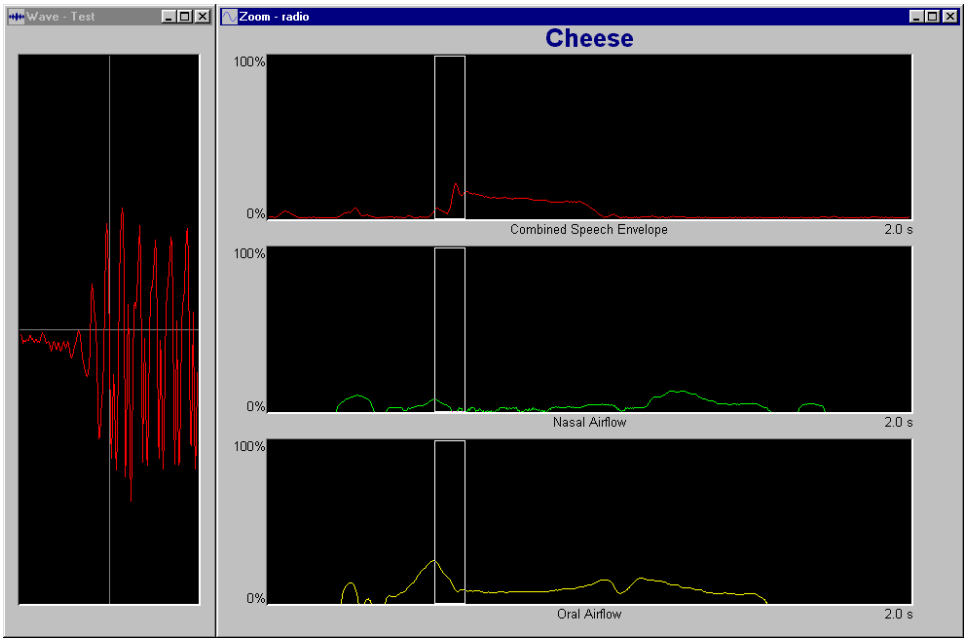
The Track Cursor appears in the main test window and the Wave display changes, to show a small sample of the audio waveform.



The Wave window shows a 20ms portion of the detailed audio waveform at the position of the cursor in the main display. The cursor can be moved with the mouse by clicking and dragging. As the cursor is moved, the Wave display changes to reflect the new cursor position. The vertical centre-line in the Wave window represents the cursor position in the main Test display. The horizontal centre-line represents the signal zero level.

Now activate the block cursor by clicking its button on the toolbar.

The Wave window now displays the detailed waveform for the region enclosed by the cursor block.



If the cursor is moved, the Wave display again changes to reflect the cursor position. If the cursor width is altered, the Wave display changes to continue to show the portion of the audio waveform representing the selection contained within the cursor block.

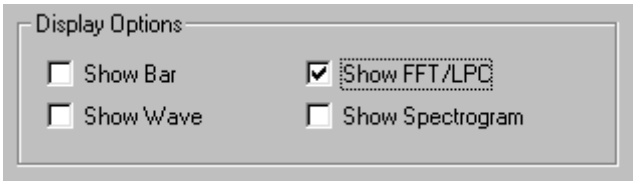
At any stage, the Wave window can be expanded to fill the display, simply by clicking the "Maximise" box at the top right-hand corner of its window.

When you have finished viewing the Wave window, it can be shrunk back to its original size and position by clicking the "Window" box, which now replaces its "Maximise" box.

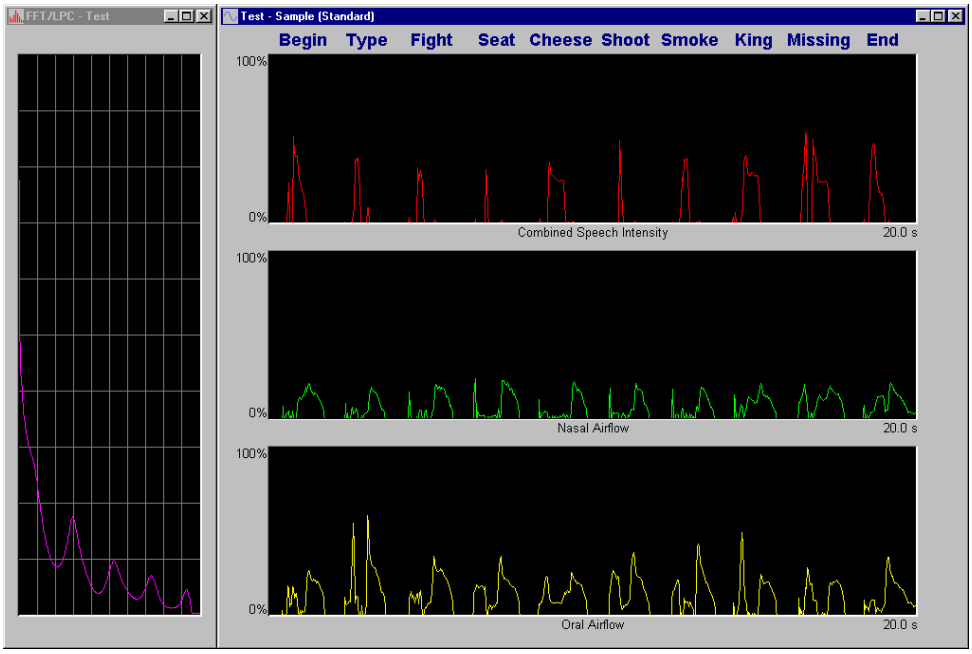
FFT/LPC – viewing the frequency spectrum at any point in the waveform

It is also possible to view the Fast Fourier Transform (FFT) or Linear Predictive Coding (LPC) of the high-resolution Speech (Sp) waveform, provided "Record Audio" was selected when the test was performed. [This is selected by default].

The easiest way to view the FFT/LPC is to select "Show FFT/LPC" at the time of recording the test. This is achieved by clicking in the "Show FFT/LPC" check box, in the "Display Options" part of the "Test Settings" dialog box.



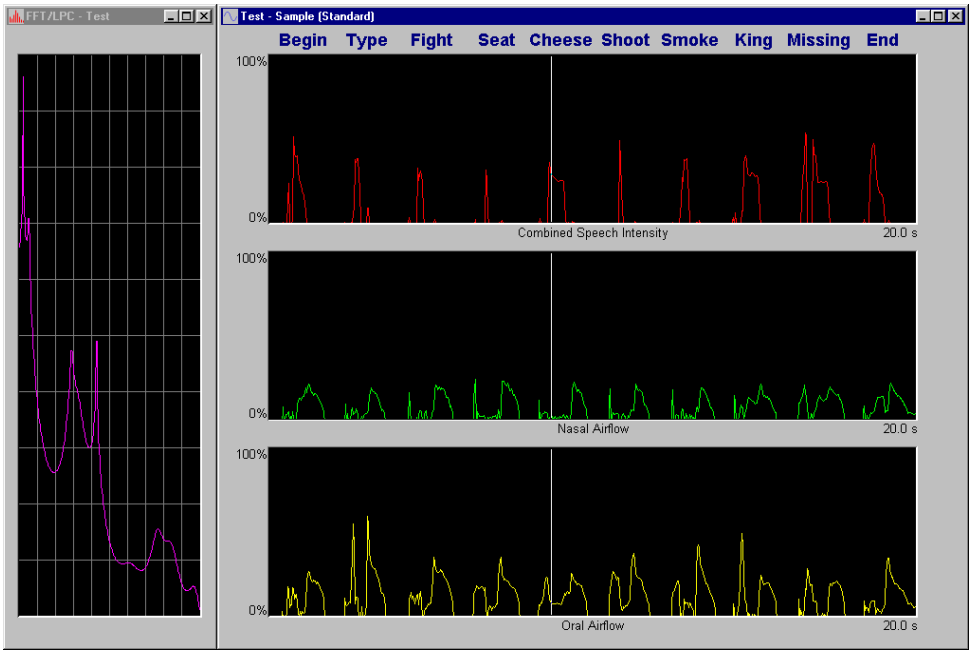
At the end of the test, the FFT/LPC window appears at the left of the display. By default, a single LPC trace is shown.



With no cursors on the screen, the FFT/LPC window displays the spectrum averaged over the entire recording. It is more useful to view the spectrum at a specific time. This is achieved using the Track Cursor, in the Scope window.

Click in the Scope window, to make it the active window, and then click on the “Show Track Cursor” button on the toolbar.

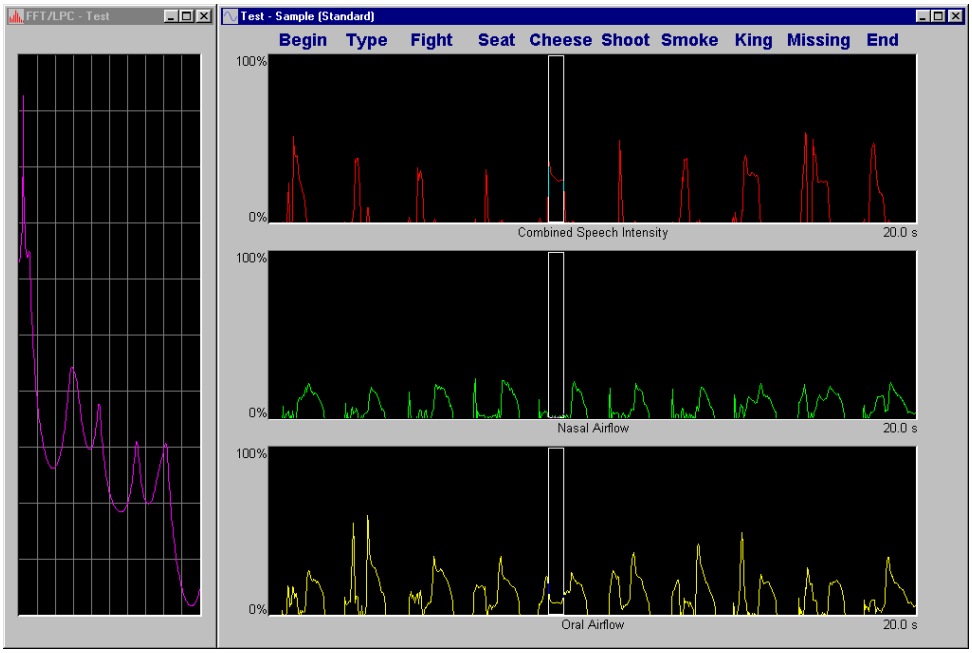
The Track Cursor appears in the main test window and the FFT/LPC display changes, to show the spectrum of the speech signal at the cursor position.



The FFT/LPC window shows the FFT/LPC for a 2048 sample section of the audio waveform, at the position of the cursor in the main display. The cursor can be moved with the mouse by clicking and dragging. As the cursor is moved, the FFT/LPC display changes to reflect the new cursor position.

Now activate the block cursor by clicking its button on the toolbar.

The FFT/LPC window now displays the FFT/LPC averaged over the region enclosed by the cursor block.

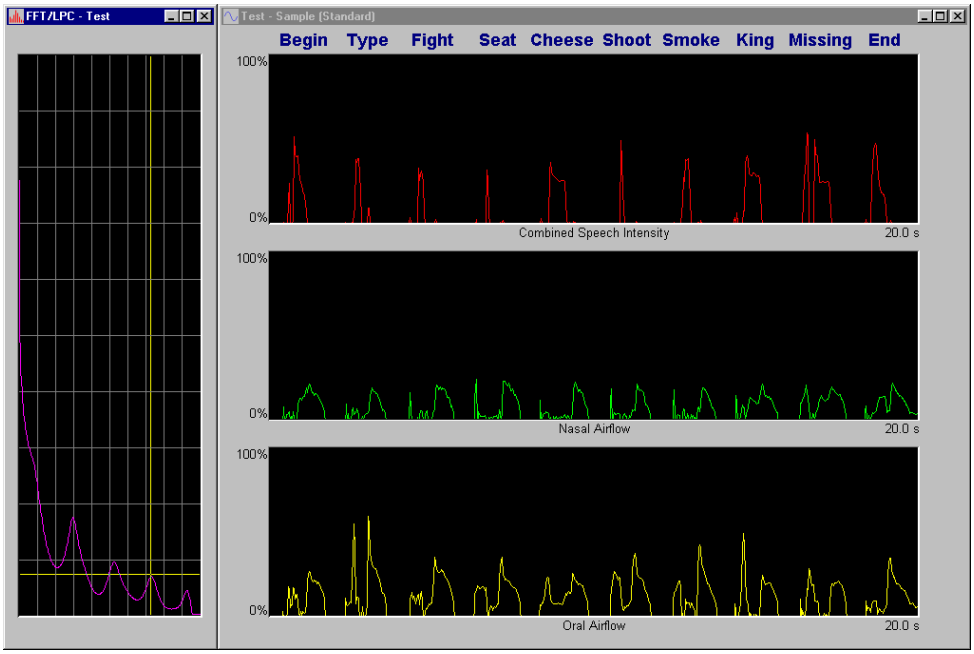


If the cursor is moved, the FFT/LPC display again changes to reflect the cursor position. If the cursor width is altered, the FFT/LPC display changes to continue to reflect the portion of the audio waveform representing the selection contained within the cursor block.

At any stage, the FFT/LPC window can be expanded to fill the display, simply by clicking the "Maximise" box at the top right-hand corner of its window.

When you have finished viewing the FFT/LPC window, it can be shrunk back to its original size and position by clicking the "Window" box, which now replaces its "Maximise" box.

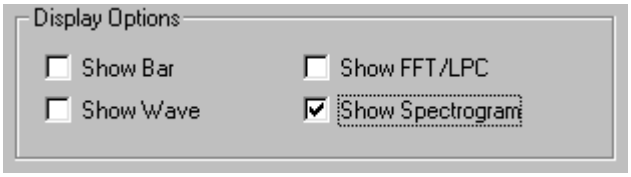
If the FFT/LPC window is the active window, clicking on the block cursor button in the toolbar activates a measurement cursor. This cursor displays the frequency and intensity information, in the status bar.



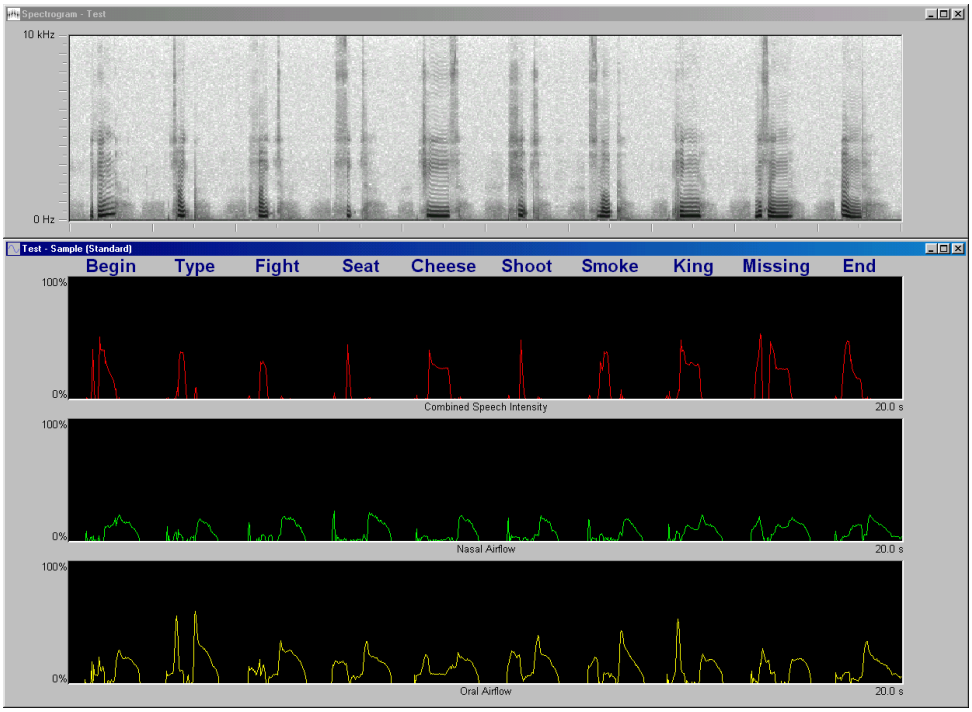
Spectrogram – viewing the time-frequency characteristics of speech

A spectrogram of the speech signal can be displayed, provided “Record Audio” was selected when the test was performed. [This is selected by default].

The easiest way to view the Spectrogram is to select “Show Spectrogram” at the time of recording the test. This is achieved by clicking in the “Show Spectrogram” check box, in the “Display Options” part of the “Test Settings” dialog box.

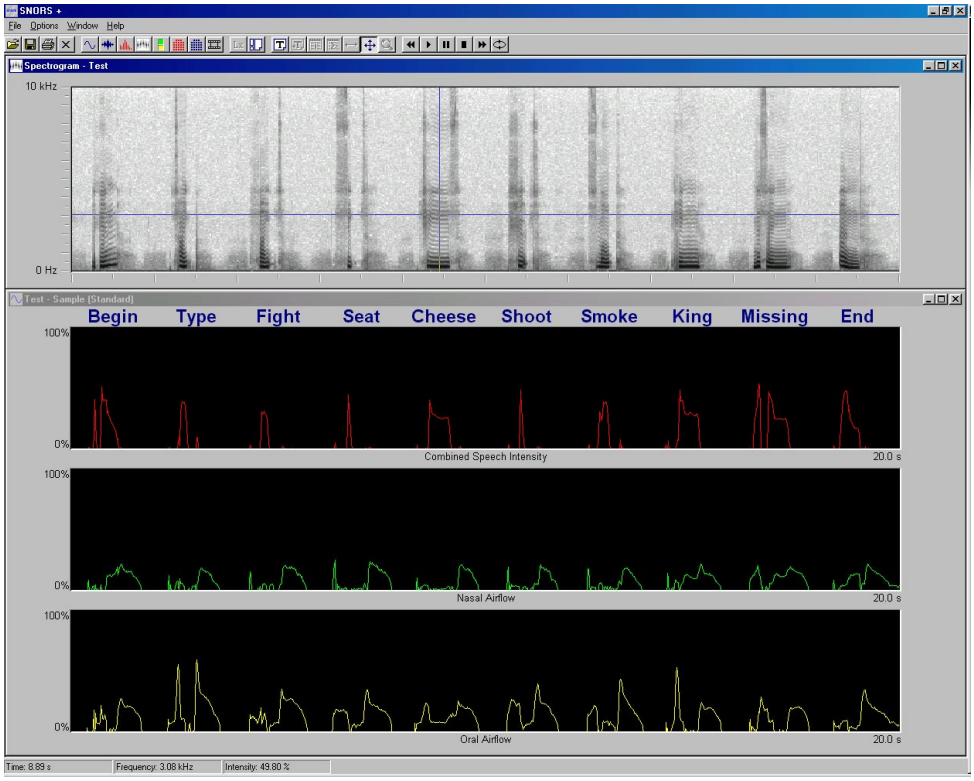


At the end of the test, the Spectrogram window appears at the top of the display.



The Spectrogram window displays the spectrogram over the period of the entire recording. The Scope and Spectrogram windows are time-aligned. If a cursor (track or block) is activated in the Scope window, it is duplicated in the Spectrogram window. Both cursors move together.

If the Spectrogram window is the active window, clicking on the block cursor button in the toolbar activates a measurement cursor. This cursor displays the time, frequency and intensity information, in the status bar.



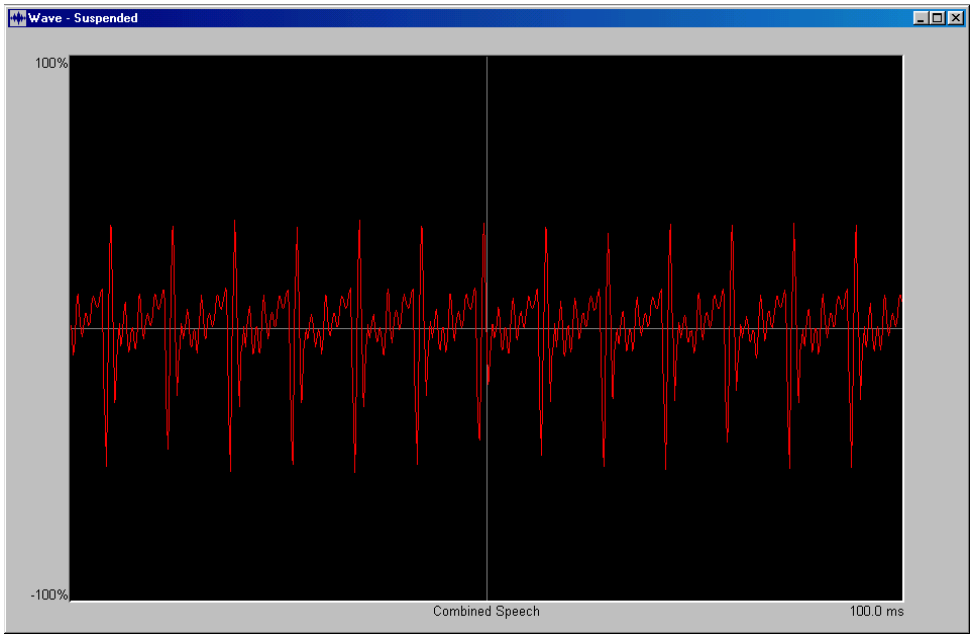
Real-time Wave, FFT/LPC and Spectrogram displays

Wave

To open the therapy Wave display, click “New Wave” on the toolbar.

Enlarge the display by clicking “Auto Arrange”, on the toolbar.

A “Wave” window opens, displaying the speech waveform in real-time (if a Laryngograph® is connected, the Lx waveform is also shown).



Ask the patient to place the mask over their nose and mouth, ensuring a good seal, and observe the waveform as they speak. Alternatively, connect the SNORS Audio unit and microphone, in place of the mask.

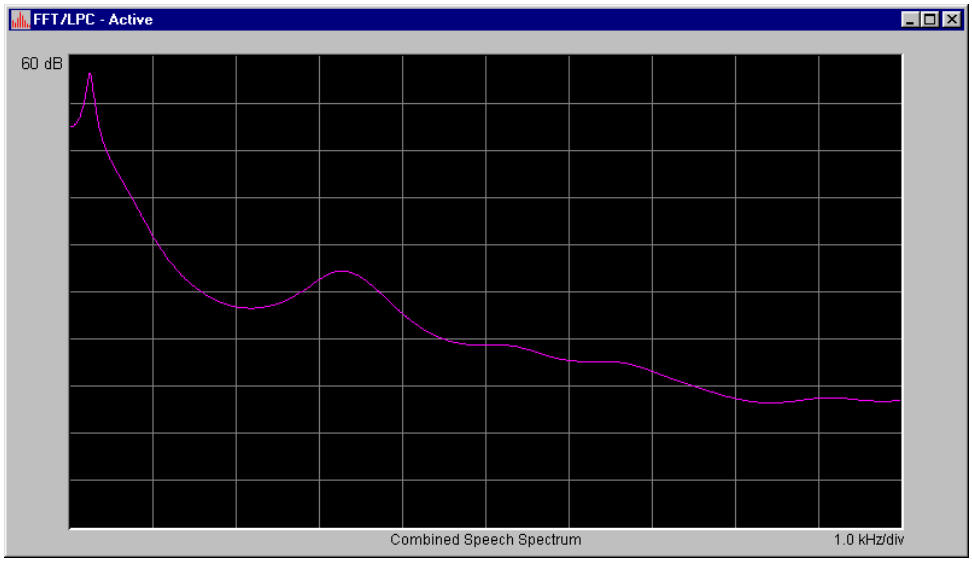
When you have finished, close the Wave window by clicking the “Close All” button on the toolbar.

FFT/LPC

To open the therapy FFT/LPC display, click “New FFT/LPC” on the toolbar.

Enlarge the display by clicking “Auto Arrange”, on the toolbar.

An “FFT/LPC” window opens, displaying the instantaneous spectrum in real-time.



Ask the patient to speak into the mask or microphone, and observe the spectrum as they speak.

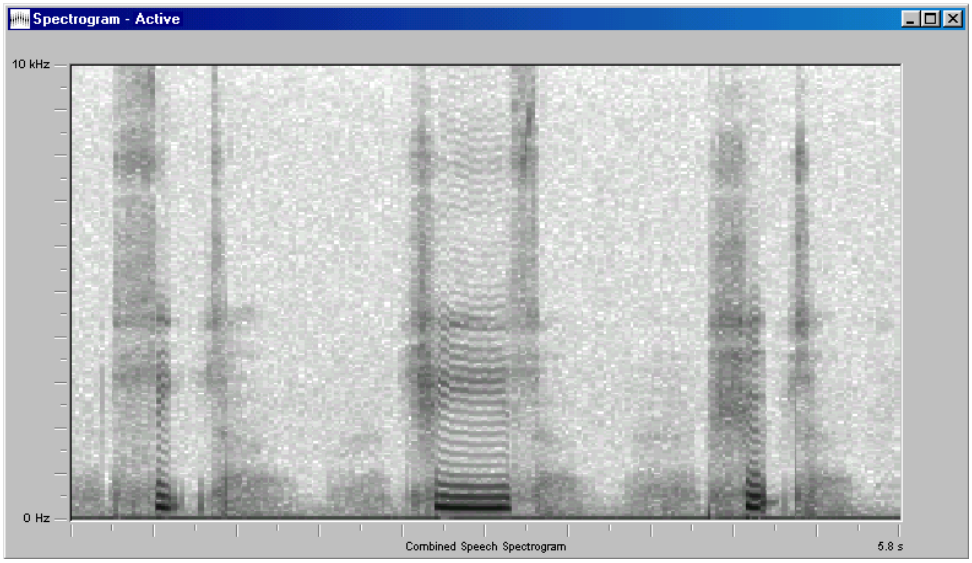
When you have finished, close the FFT/LPC window by clicking the “Close All” button on the toolbar.

Spectrogram

To open the therapy Spectrogram display, click “New Spectrogram” on the toolbar.

Enlarge the display by clicking “Auto Arrange”, on the toolbar.

A “Spectrogram” window opens, displaying the spectrogram scanning across the display.



Ask the patient to speak into the mask or microphone, and observe the spectrogram as they speak.

When you have finished, close the Spectrogram window by clicking the "Close All" button on the toolbar.

Note: For more detailed information on FFT/LPC and Spectrogram, please refer to Chapter 9 – "Research Features".

Audio Playback

In addition to the "Play" button, a full range of tape recorder style controls is provided for audio/video playback and animation.

The "Play" button starts playback. If no cursor is activated, playback commences at the left-hand edge of the active window and ends at the right-hand edge of the window. If a track cursor is active, playback commences at the cursor and ends at the right-hand edge of the window. If a block cursor is active, playback commences at the left-hand edge of the block and ends at the right-hand edge of the block.

Pressing the "Pause" button stops playback. The animation cursor (dotted line) remains in place at the point where playback was stopped. Pressing "Pause" a second time restarts playback from where it left off.

The "Stop" button stops playback and resets the animation cursor.

By pressing the "Loop Playback" button audio can be replayed continuously (until "Stop" is pressed), by pressing the "Play" button.

Finally, the "Skip Backwards" and "Skip Forward" buttons cause the Track or Block cursor (if active) to move in the appropriate direction. "Stop" is functional during this process and functions to stop the cursor where it is (i.e. it does not reset the cursor). "Pause" and "Loop Playback" do not function during the skip functions.

Because sound recording is fully synchronised with the data recording, it is possible to utilise the cursors to listen to specific portions of the sound and so identify precisely which sections of the waveforms correspond to which sounds.

File Handling

So far, the basic opening and saving of complete tests in their default folder have been considered. However, SNORS+ allows many options regarding what is saved or opened and where it is stored.

Saving

Test

If "Save" is selected immediately after a test is complete, the complete test is saved in the default folder (C:\SNORS +\Test data files). The complete test will also be saved whenever a main test window (one whose name starts "Test" and which displays the complete word list) is the active window.

If a "Zoom" view of part of a test (either a single word or a selected portion) is the active window when "Save" is invoked, the user will be given the choice of saving either the complete test[5] or just the portion of the test visible in the active window (e.g. a single word).

Saving just a part of the test, either instead of or as well as the complete test, is useful, as it requires much less disk space than the complete test. This is particularly important when audio has been recorded, in which case the complete test file is normally too large to fit on a floppy disk.

Bar

When a Bar window is active, "Save" will store a static image of the Bar window in the default folder (C:\SNORS +\Bar data files).

EPG

When an EPG window is active, "Save" will store a static image of the EPG window in the default folder (C:\SNORS +\EPG data files).

[5] The choice of saving the entire test will only be offered if the "Test" window is still open and it has not already been saved.

FFT/LPC

When an FFT/LPC window is active, “Save” will store a static image of the FFT/LPC window in the default folder (C:\SNORS +\FFT data files).

Scope

When a Scope window is active, “Save” will store a static image of the Scope window in the default folder (C:\SNORS +\Scope data files).

Spectrogram

When a Spectrogram window is active, “Save” will store a static image of the Spectrogram window in the default folder (C:\SNORS +\Spectrogram data files).

Video

When an Video window is active, “Save” will store a static image of the Video window in the default folder (C:\SNORS +\Video data files).

Wave

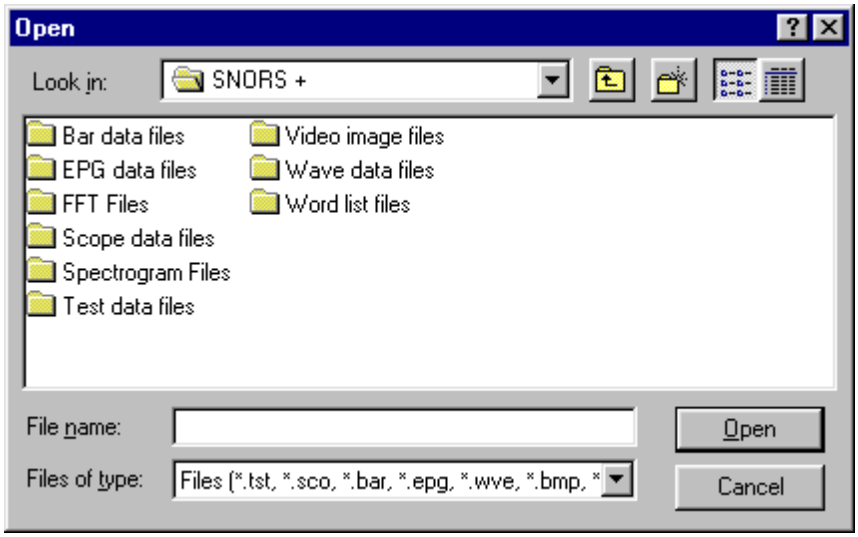
When a Wave window is active, “Save” will store a static image of the Wave window in the default folder (C:\SNORS +\Wave data files).

Note

As well as after a Test, Bar, EPG, FFT/LPC, Scope, Spectrogram, Video and Wave windows can be saved during therapy. Simply freeze the display, by pressing the “Pause” key on the keyboard, and then click on the “Save” button on the toolbar.

Opening

Test, Bar, EPG, FFT/LPC, Scope, Spectrogram, Video and Wave files can all be opened by clicking the “Open” button on the toolbar. When selecting Open for the first time in a SNORS+ session, the default folder will be used (C:\SNORS +) and a list of file folders will appear (one for each of Test, Bar, EPG, FFT/LPC, Scope, Spectrogram, Video and Wave files).



The appropriate folder should be opened and the required file selected. SNORS+ remembers which folder you last opened, so next time you select Open, you will automatically be in the folder that you opened last.

Structuring your filing

If you save all of your files in the same folder, you will soon accumulate a vast number of files and it will be difficult to find any particular file to open. Hence it is recommended that you create sub-folders within the default SNORS+ file folders. How you organise your files is a matter of personal preference – you should use whatever approach you are comfortable with. You may, for example, use one folder per patient. Or you might prefer to create different folders for each therapy session. As you can nest folders to any depth, you could even do both, having session folders within patient folders, for example.

To make it easier to review a set of files, SNORS+ remembers the last folder that you opened. Therefore, when you select Open, you will automatically be in the same folder that you opened last time.

It is also helpful if you use meaningful names for your files and folders. Windows 95/98® allows the use of very long names (up to 256 characters), so it should be possible to find appropriate names.

Chapter

7

Multiparameter use

How to use SNORS+ for multiparameter measurement

This chapter describes how to use SNORS, in combination with Linguagraph and/or Laryngograph®, as a multiparameter speech workstation. It also shows how to make simultaneous video recordings.

Connecting the hardware

Before using SNORS+, it is necessary to connect the hardware together as a multiparameter system. To configure SNORS+ for multiparameter assessment, proceed as follows.

1) Make sure that the computer is switched off and disconnected from the mains.

2) If not already done, connect the SNORS+ Base Unit and SNORS Mask. Also connect the Audio Cable. [See Chapter 3 – "Getting Started – SNORS"].

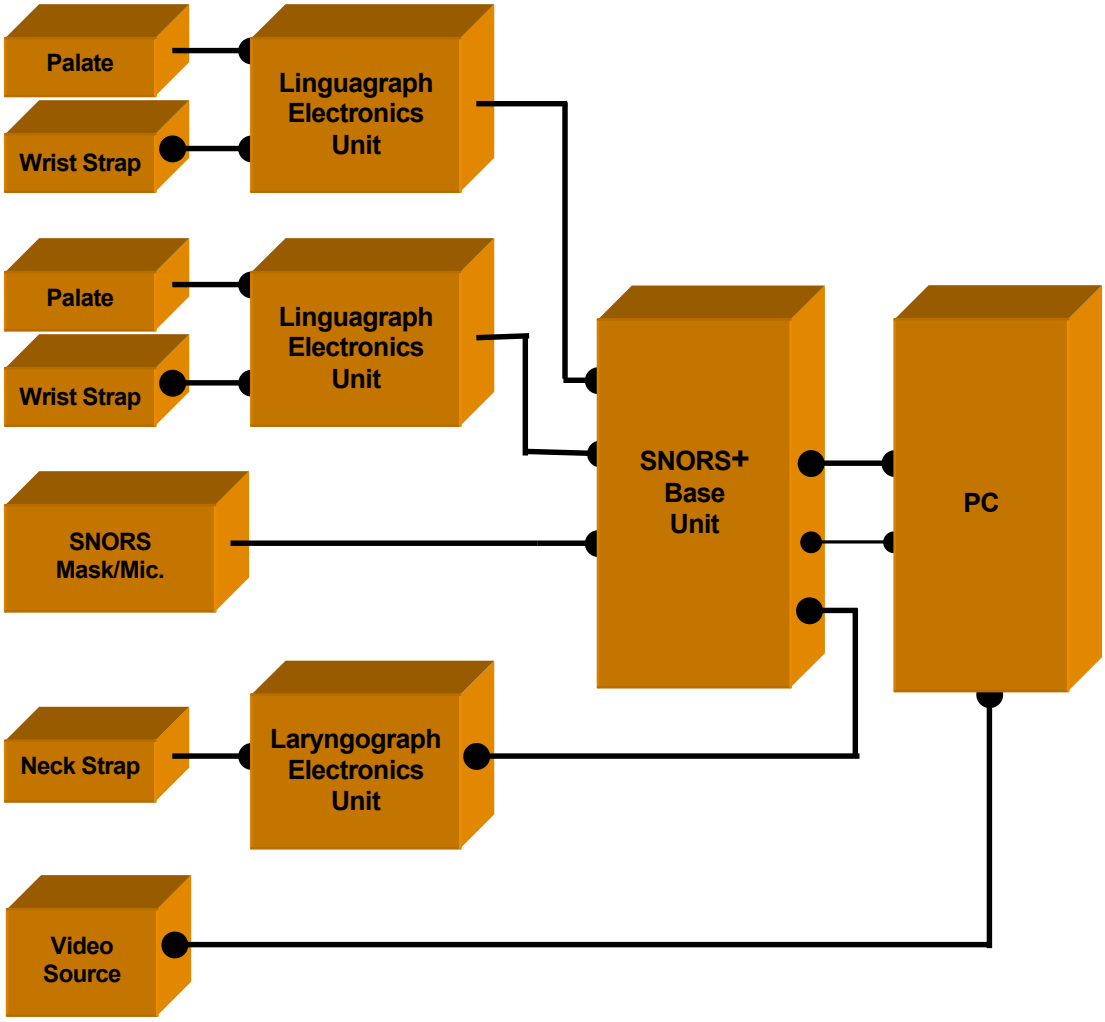
3) Plug one or two Linguagraph electronics units into the interface unit. The Linguagraph plug, which is on the end of the lead coming out of the unit, is of a similar type to the SNORS Mask plug, except that it is larger. Plug it into the matching socket on the front of the Base Unit, ensuring that it is the correct way round (align the red marks). If only one Linguagraph is to be used, plug it into the Linguagraph 1 socket.

4) Plug the Linguagraph wrist strap lead into the small socket on the Linguagraph electronics unit. The wrist strap lead is the coiled, yellow lead, which is fitted to the wrist strap by means of a press-stud.

5) Connect the Laryngograph® PCLX electronics unit to the SNORS+ interface unit, using the black lead, which has a round silver coloured connector on each end. The lead connects between the matching connector on the rear of the interface unit and the Aux. output connector on the Laryngograph® PCLX electronics unit. The connectors simply push in – be careful that the pins are aligned correctly with the socket holes. Both ends of the lead are identical, so it does not matter which end goes where.

6) Plug the Laryngograph electrode neck strap into the Laryngograph® electronics unit. Note that the plug has a flat face on one side and only fits one way round. Set the Lx sensitivity control knob to half way.

7) Connect the video source to the "Video In" connector on the video capture card in the PC, using a lead appropriate to your video source.



8) Now plug in and switch on the computer. Once it has booted (this may take a few minutes) the system is ready to use.

SNORS plus Laryngograph®

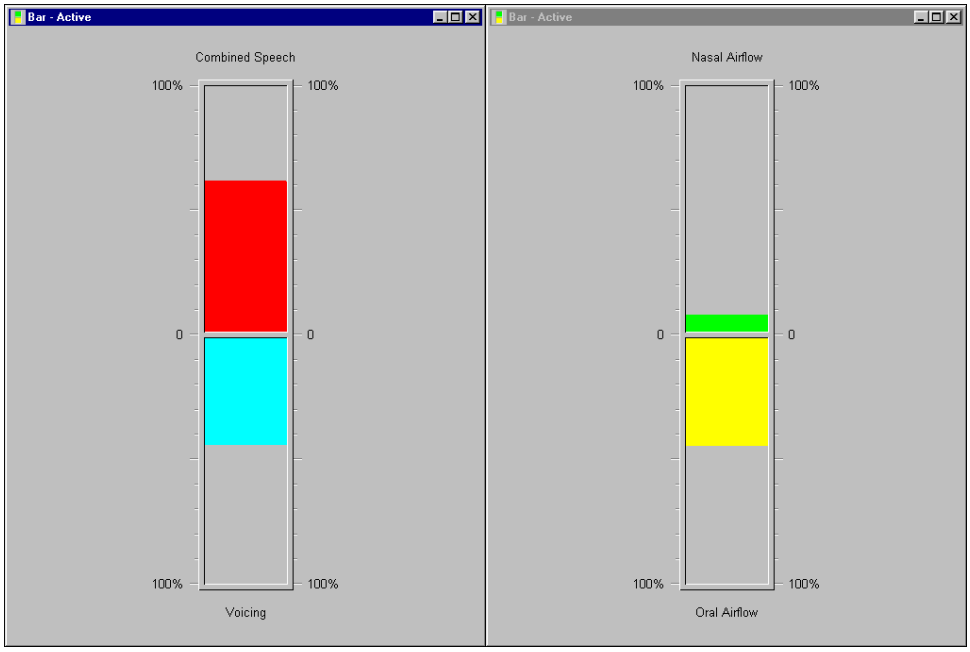
Therapy

Voice therapy generally requires detailed parameters such as "Shimmer" and "Jitter" to be displayed. As SNORS+ only provides Voicing Intensity and Fundamental Frequency data in real-time, it is recommended that the full PCLX software, supplied by Laryngograph Ltd, be used for therapy. For basic therapy, however, real-time displays of Voicing Intensity (Lx envelope), either in Bar or Scope form can be activated, as follows.

Bar

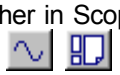
To use SNORS and Laryngograph® together, after starting the SNORS+ package, click "New Bar", followed by "New Bar" (again), then "Lx", and finally "Auto Arrange", on the toolbar.

SNORS and Laryngograph® Bar displays will appear, side by side, on the screen.

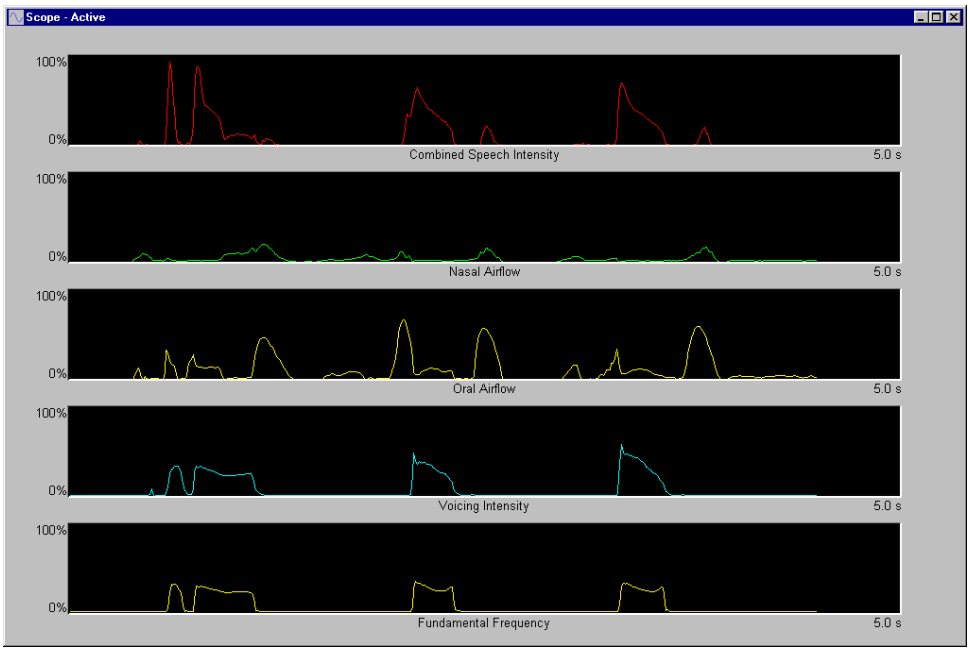


Ask the patient to produce the required sounds or words and observe the displays, with the patient. The displays can be paused by pressing the "Pause" key and restarted by pressing the "Pause" key again.

Scope

To use SNORS and Laryngograph® together in Scope mode, click the "New Scope" and "Auto Arrange" buttons on the toolbar. 

A Scope window opens with five traces – Speech Intensity, Nasal Airflow, Oral Airflow, Voicing Intensity and Fundamental Frequency.

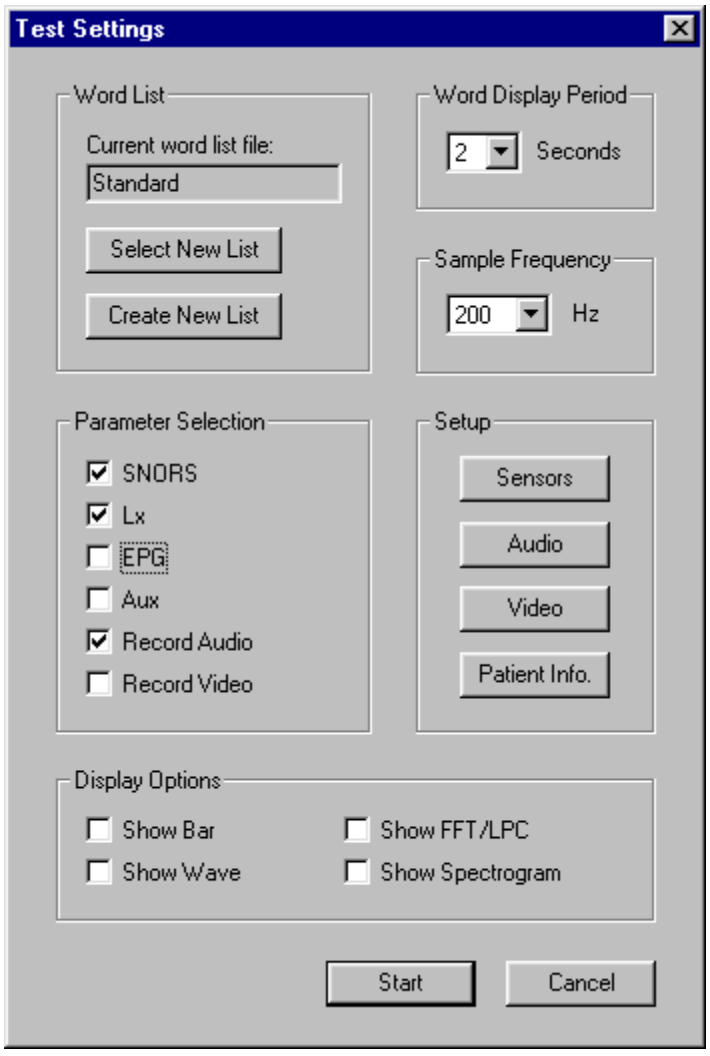


As for standalone SNORS, Scope is also useful in therapy as it allows patients to observe the dynamics of their speech. Thus it is useful when working with clusters or words.

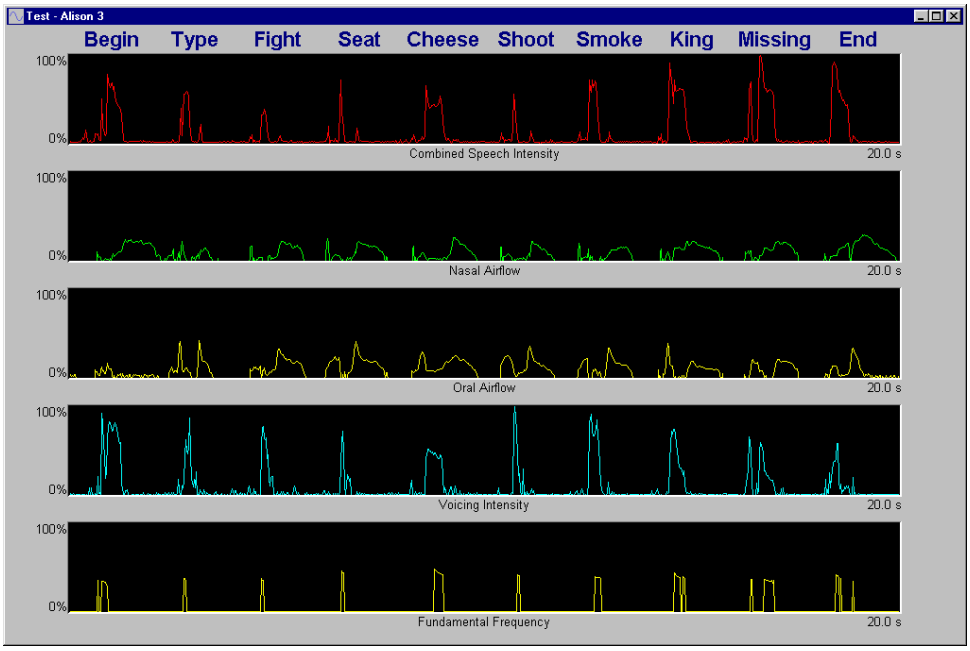
Assessment and Analysis

To carry out an assessment test, using SNORS and Laryngograph®, first press the "New Test" button on the toolbar, as for starting SNORS alone.

In the "Test Settings" dialog box, check that the "Laryngograph Lx" check box is ticked. If necessary, deselect EPG by clicking in its check box..



Switch on the Laryngograph® unit. Place the Laryngograph® electrode strap around the patient's neck, so that the electrodes sit comfortably either side of the thyroid cartilage [see your Laryngograph® manual for further details] and get the patient to hold the SNORS mask over their nose and mouth. Then proceed with the test, in the normal way. At the end of the test, the usual Test window appears, but there are five traces instead of the normal three ("Voicing intensity" and "Fundamental Frequency channels are added).



Analysis is carried out as for stand-alone SNORS, but two additional traces are present (Voicing Intensity and Fundamental Frequency).

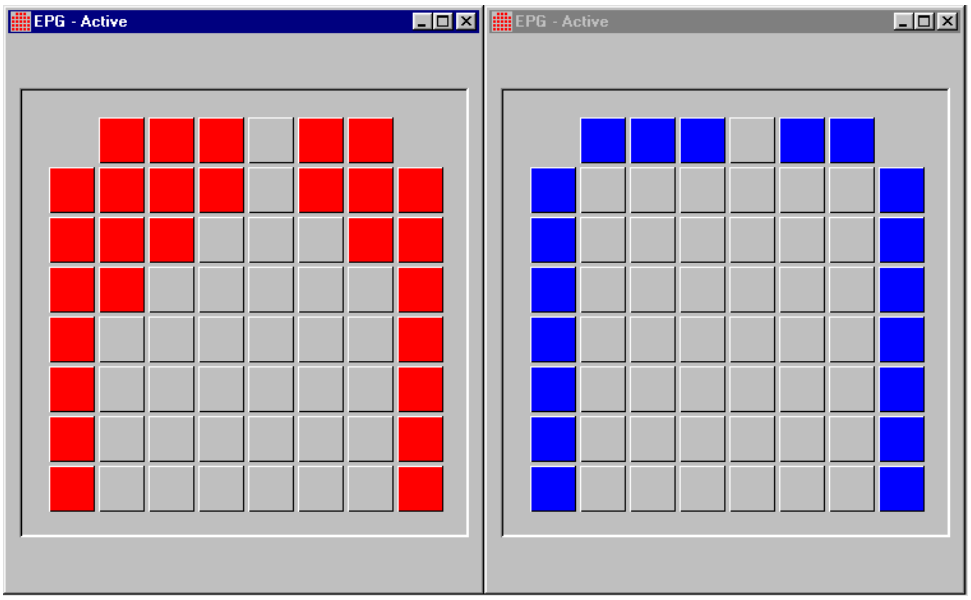
Adding Linguagraph

Therapy

Dual channel Linguagraph

As well as being able to combine Linguagraph with other instruments, SNORS+ provides the facility to use two Linguagraphs together. To use two Linguagraphs for therapy, in simultaneous real-time mode, after starting the SNORS+ package, simply click on the "New EPG" button twice, followed by "Auto Arrange".

Two EPG displays will appear on the screen – one red and one blue – as when using a single Linguagraph and a stored model. However, for two-channel operation, both displays will be active.



Two-channel mode allows the therapist and patient both to have a Linguagraph, so that the therapist can demonstrate contact patterns to the patient. When doing this, it is often useful to freeze one or other display on the screen. This can be achieved as follows:

To pause (freeze) both displays, press the "Pause" key, on the keyboard.

To restart the displays, press "Pause" again.

To freeze one display only, first click on the display that you wish to freeze. This will make it the "active window" – its title bar will usually be blue[6]. Then press the "S" key on the keyboard, to suspend (freeze) the display.

To restart the display, press the "A" key, to activate the display.

In summary:

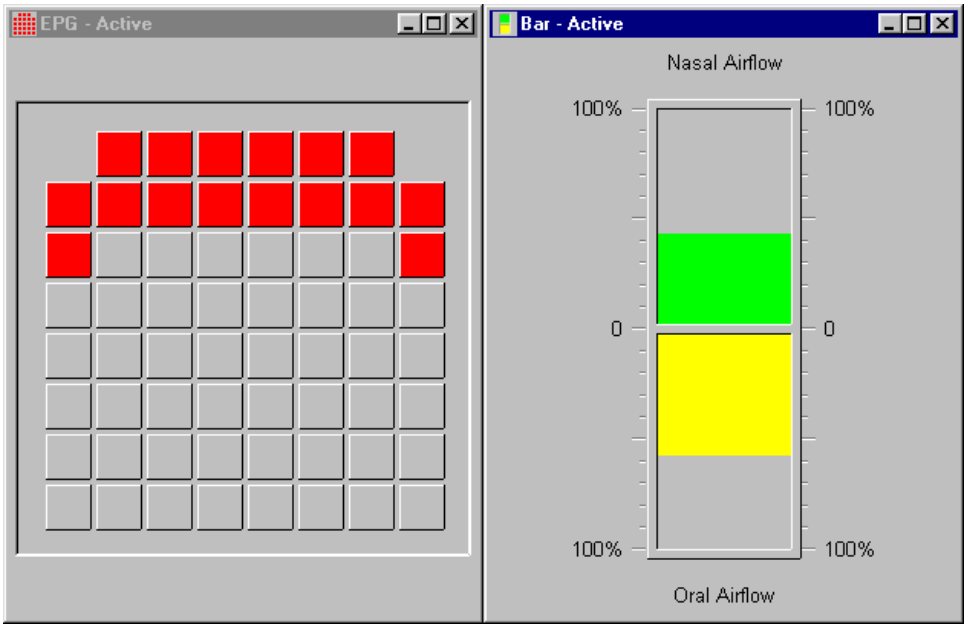
- "Pause" acts on all windows.
- "S" and "A" act on the active window only.

SNORS plus Linguagraph

To use SNORS and Linguagraph together, after starting the SNORS+ package, click "New Bar", followed by "New EPG" and finally "Auto Arrange", on the toolbar.

Bar and EPG displays will appear, side by side, on the screen.

[6] Blue is the default colour for Title Bars. However, if you have altered your "Desktop" settings, another colour may be used.

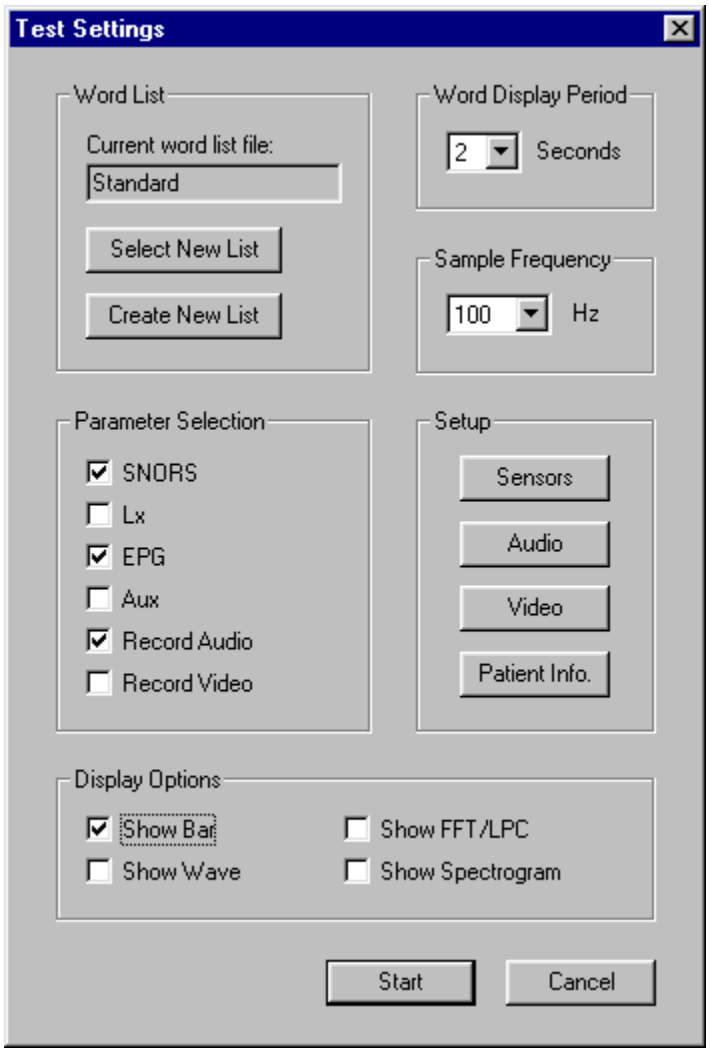


Ask the patient to produce the required sounds or words and observe the displays, with the patient. The displays can be paused by pressing the “Pause” key and restarted by pressing the “Pause” key again.

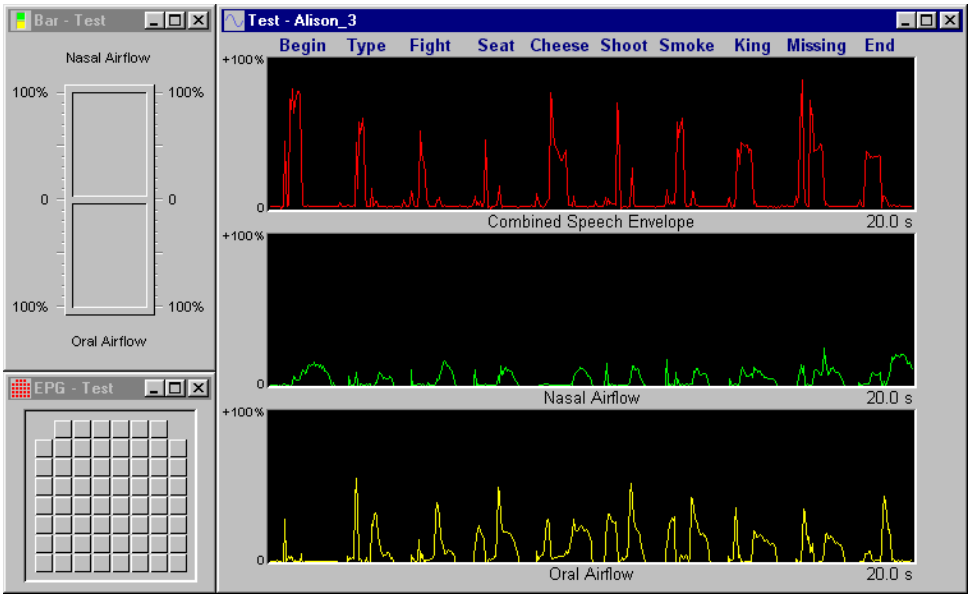
Assessment and Analysis

To carry out an assessment test, using SNORS and Linguagraph, first press the “New Test” button on the toolbar, as for starting SNORS alone.

In the “Test Settings” dialog box, check that the “Linguagraph EPG” check box is ticked and click in the “Show Bar” check box. Ticks will appear in these check boxes. If necessary, deselect Laryngograph® by clicking in the “Lx” check box.



Place the electropalatography palate in the patient's mouth, ensuring a firm, comfortable fit, and ask them to hold the mask over their nose and mouth, and then proceed with the test, in the normal way. At the end of the test, the usual Test window appears, but there will be additional Bar and EPG windows. [Note, it is not essential to select "Show Bar" – you can just add "Linguagraph EPG", if you wish. However, bar provides a comparable snapshot of airflow. Alternatively, "Show Wave" can be substituted for "Show Bar" – see later]



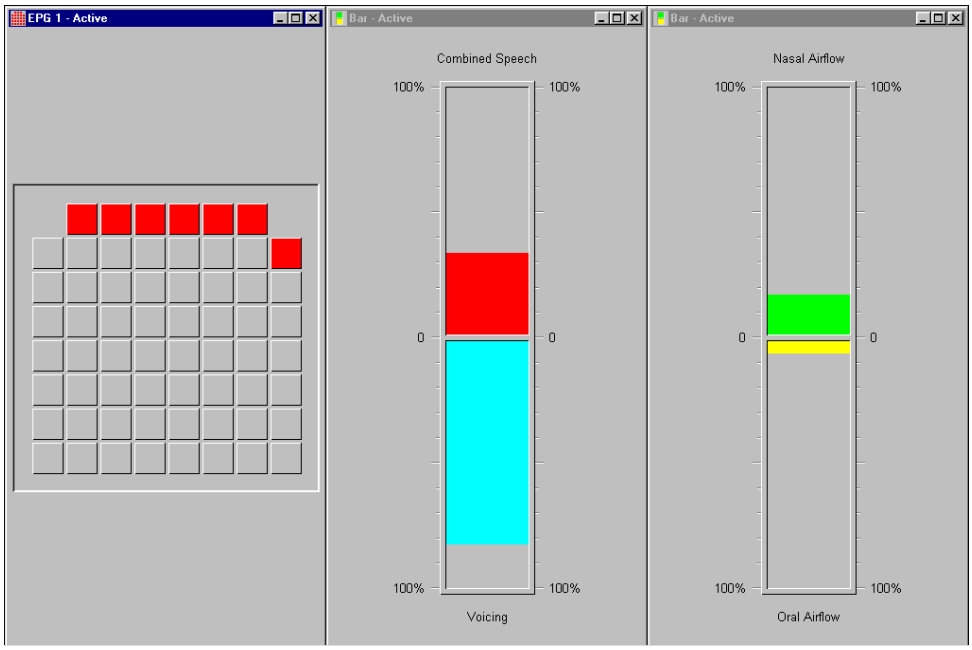
Analysis is carried out as for stand-alone SNORS but, as the cursor is moved along the traces, the EPG snapshot changes to reflect the tongue-palate contact at the current cursor position. When the block cursor is active, mean contact values will be indicated, using a "grey scale" (actually red, but the colour intensity represents the persistence of contact during the time within the block cursor box).

SNORS plus Laryngograph® plus Linguagraph

Therapy

It is not recommended that all three parameters be used, during therapy, due to the large amount of information that would be presented to the patient, in real-time. However, if required, this can be achieved by making appropriate selections from the toolbar, followed by clicking the "Auto Arrange" button, i.e.

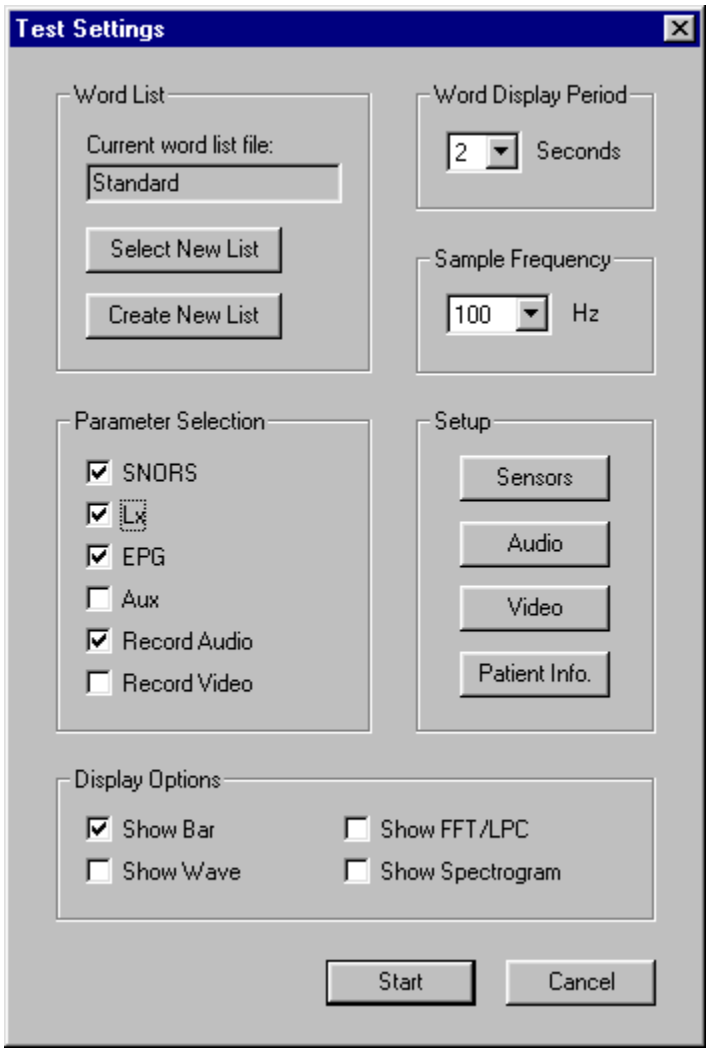
Three windows appear, displaying EPG, Voicing Bar and SNORS Bar.



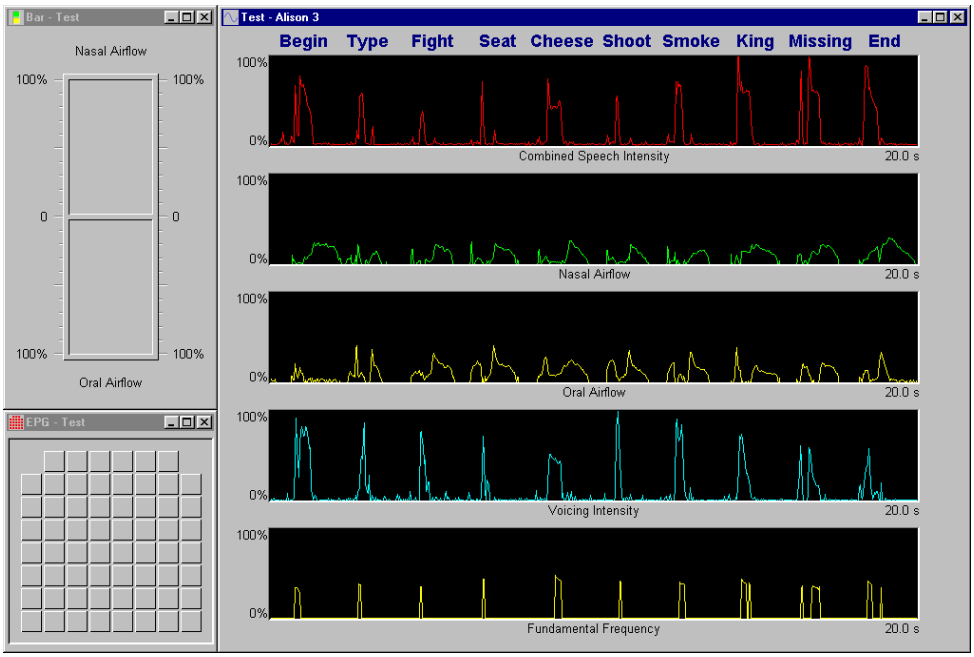
Assessment and Analysis

To carry out an assessment test, using SNORS, Laryngograph® and Linguagraph, first press the “New Test” button on the toolbar, as for starting SNORS alone.

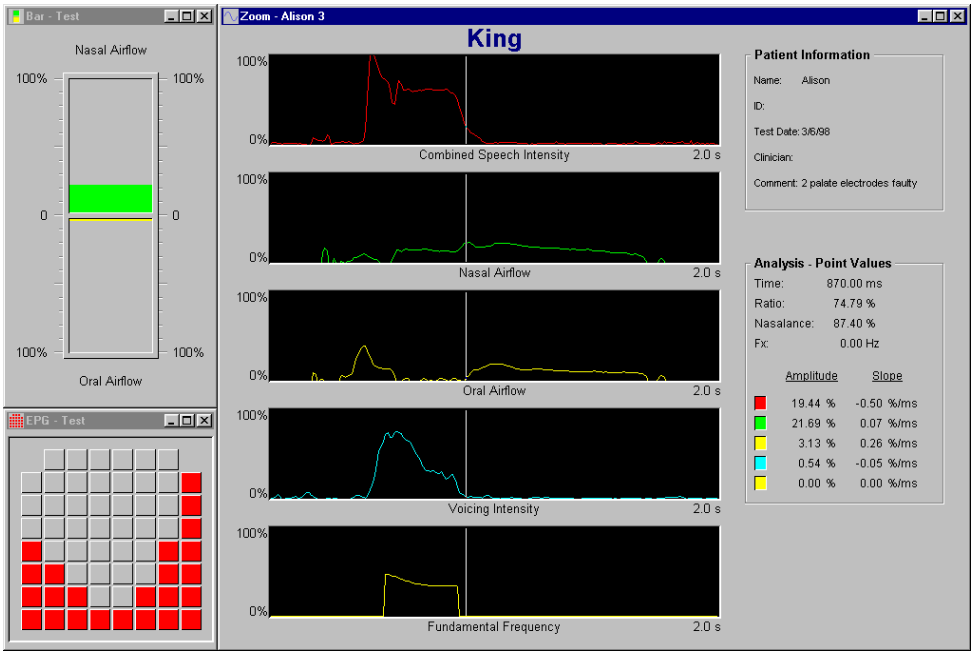
In the “Test Settings” dialog box, check that the “SNORS”, “Lx”, “EPG” and “Show Bar”, check boxes are ticked. [Once again, “Show Bar” can be omitted or substituted with “Show Wave”, as required.]



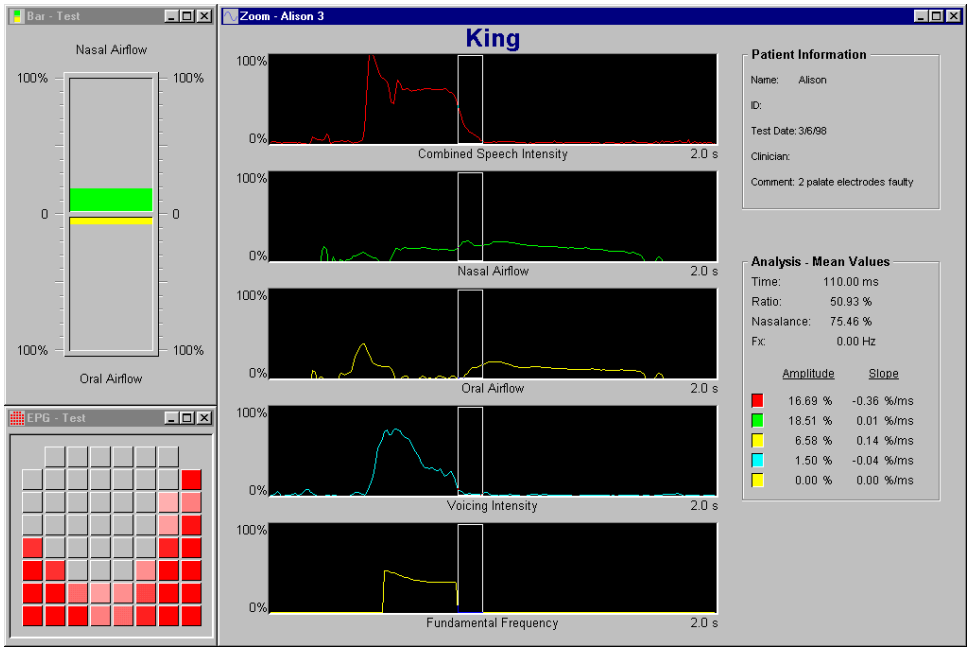
If necessary, switch on the Laryngograph® unit. Place the Laryngograph® electrode strap around the patient's neck, so that the electrodes sit comfortably either side of the thyroid cartilage. Place the electropalatography palate in the patient's mouth, ensuring a firm comfortable fit, and connect to the Linguagraph hardware, as before. Finally, ask the patient to hold the SNORS mask over their nose and mouth, and then proceed with the test, in the normal way. At the end of the test, the usual Test window appears, but there will be additional "Voicing intensity" and "Fundamental Frequency" traces as well as Bar and EPG windows.



Analysis is carried out as for stand-alone SNORS but, as the cursor is moved along the traces, the EPG snapshot changes to reflect the tongue-palate contact at the current cursor position.



When the block cursor is active, mean contact values will be indicated, using a “grey scale” (actually red, but the colour intensity represents the persistence of contact during the time within the block cursor box).



Sound & Laryngograph Waveform Features

All sound waveform features are functional in multiparameter configuration.

Audio Playback

In multiparameter use, **all** open windows are updated as the animation cursor tracks the test waveforms during playback.

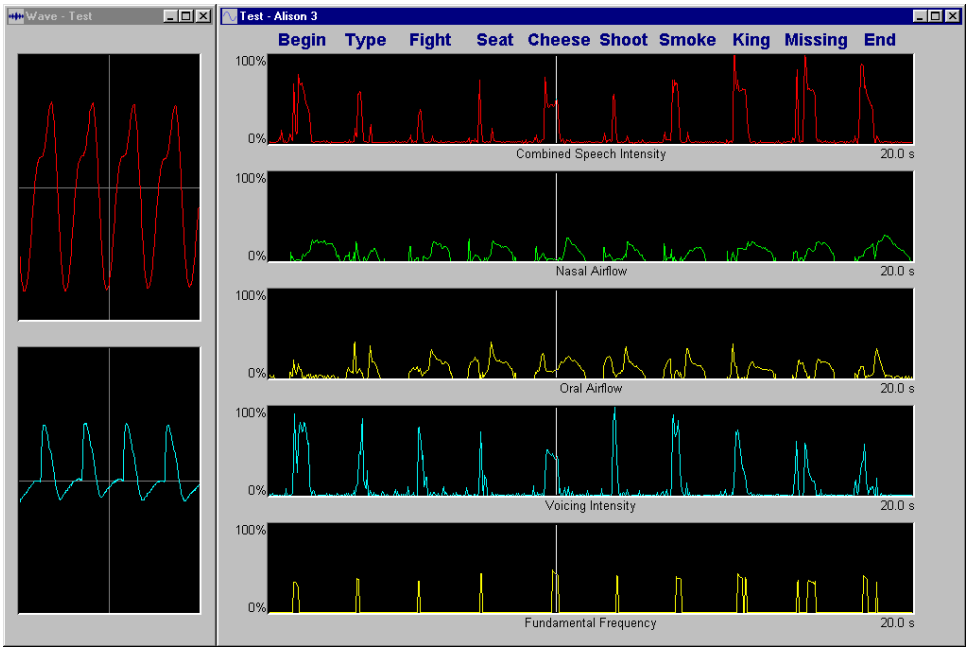
Wave

If Laryngograph® is used, it is possible to view both the high resolution Speech (Sp) and Laryngograph® (Lx) waveforms. (Provided "Record Audio" was selected when the test was performed).

Open a Test that was recorded using Laryngograph® and audio, with "Show Wave" selected, by clicking the "Open" button on the toolbar, double clicking on the "Test data files" folder, and then double-clicking on the required test data file.

Once the test is displayed, click the "Show Track Cursor" button on the toolbar.

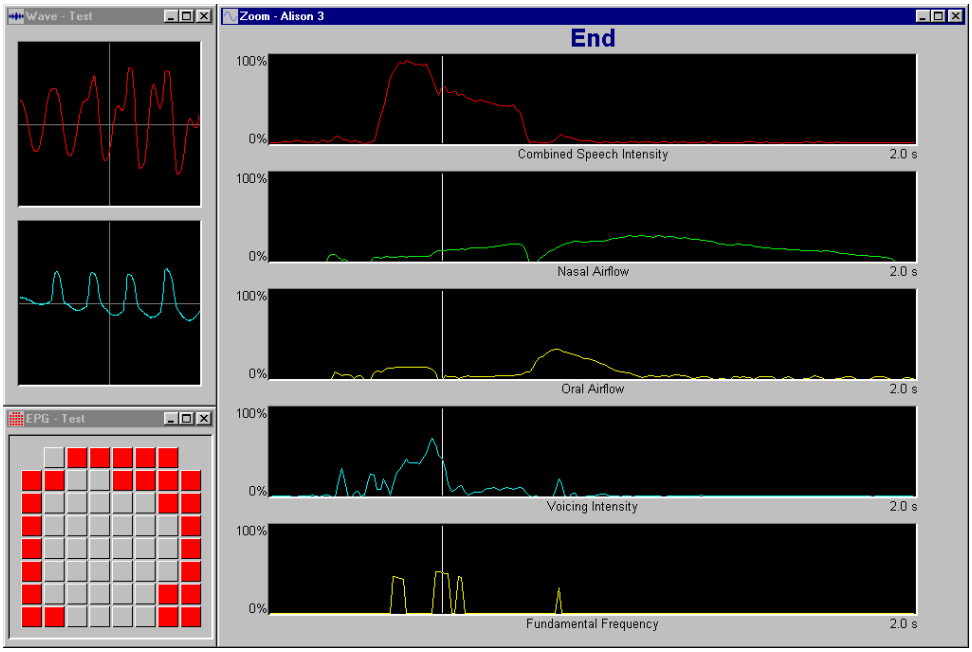
The Wave window appears at the left of the display and a track cursor is placed in the Scope window.



The Wave window shows the detailed Sp and Lx waveforms[7] at the position of the cursor in the main display. The cursor can be moved with the mouse by clicking and dragging. As the cursor is moved, the Wave display changes to reflect the current cursor position.

If the block cursor is activated, the Wave window displays the detailed waveforms for the region enclosed by the cursor block, as before.

The Wave window can be displayed in any combination of multiparameter windows. If recording with Linguagraph, it is recommended that Wave be selected instead of Bar in order to produce a less cluttered display.



[7] These waveforms are colour coded to match their respective envelope waveforms.

Adding Video

Therapy

Stand-alone Video

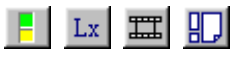
To use Video, as a stand-alone tool for therapy, after starting the SNORS+ package, simply click on the "Video" button on the toolbar.

A Video window will open.

Video is useful in therapy for feeding back an image to the patient, such as a close-up of their lips. This mode is also useful for aligning the patient's head, prior to recording a videofluoroscopy session.

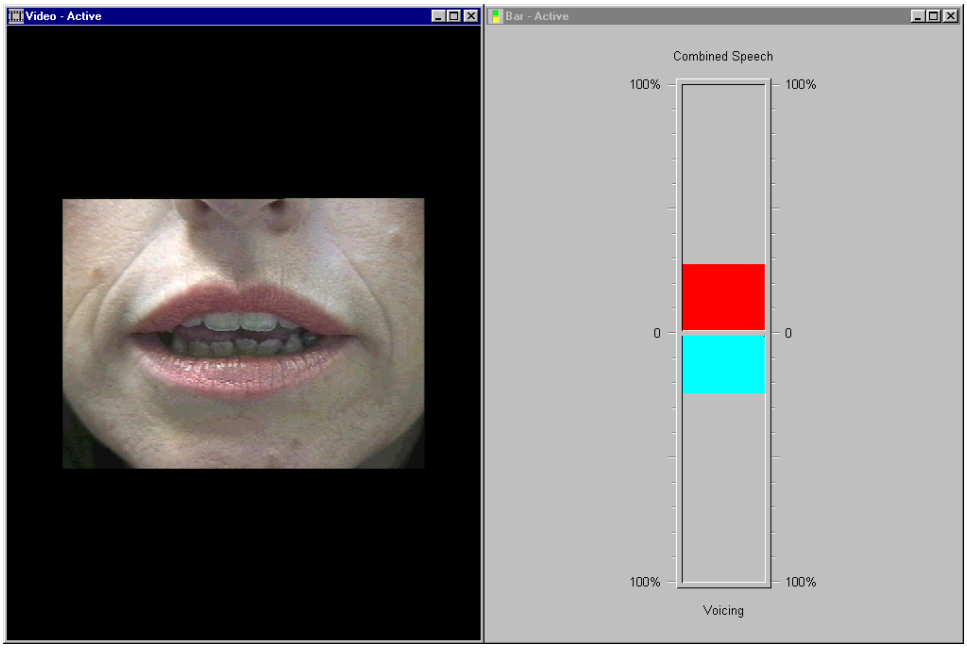
Video + other parameters

It is possible to open a Video window in conjunction with any number of other real-time windows (Bar, Scope or EPG). This is achieved simply by clicking the relevant buttons on the toolbar. To display a Laryngograph® Bar and a Video window, for example, click on "New Bar", "Lx" [8], "Video" and "Auto Arrange" buttons.



[8] Note: if SNORS is not connected, it is not necessary to click "Lx", as it is then selected by default.

The two windows appear side-by-side, in the display.

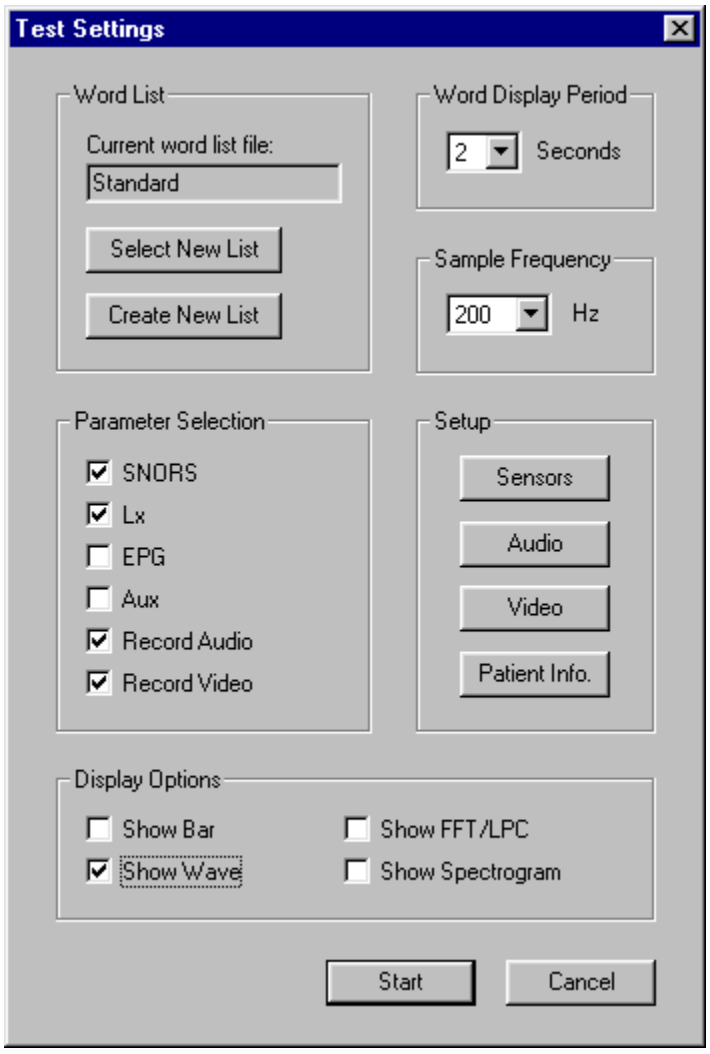


Assessment and Analysis

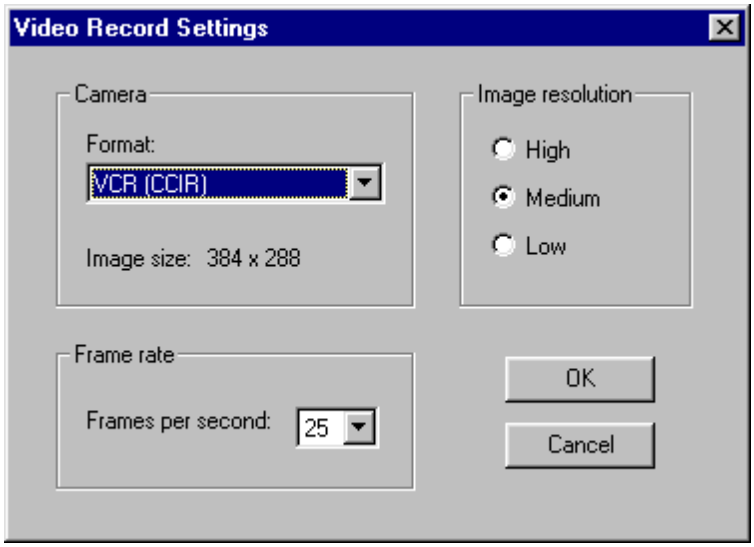
To carry out an assessment test, incorporating Video, first press the “New Test” button on the toolbar, as for starting SNORS alone.

In the “Test Settings” dialog box, click in the relevant check boxes. For example, to record standard SNORS, plus Voicing from Laryngograph®, and simultaneous videofluoroscopy images, click in the “Record Video” and “Show Wave”[9] check boxes.

[9] Optional



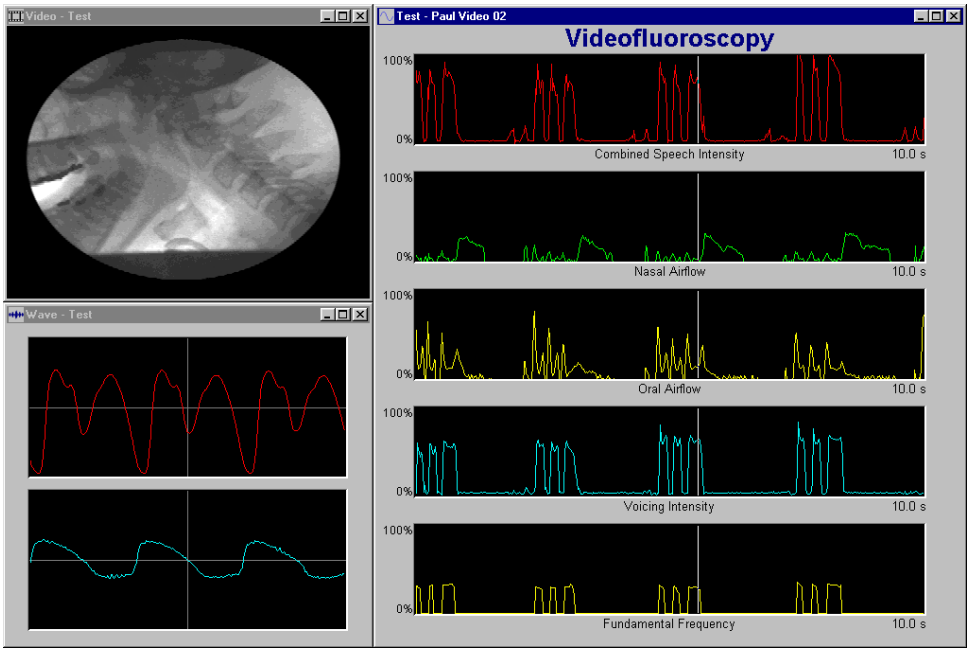
If necessary, set the video parameters, by clicking the “Video” button in the “Setup” section of the ”Test Settings” dialog box.



The “Camera” format section of the Video Record Settings dialog box allows the appropriate video source to be selected. Formats commencing VCR… are designed specifically for recording from videotape. These should not be used with live sources.

The “Image size” can be varied by selecting High, Medium or Low resolution from the “Image Resolution” section. Finally, the “Frame rate” can be set, as required. It is usually best to set the frame rate to match that of the video source.

When all necessary settings have been made, position the patient in the videofluoroscopy equipment (a real-time Video window can be used, during initial screening, to view the X-ray image). Switch on the Laryngograph® unit. Place the Laryngograph® electrode strap around the patient’s neck, so that the electrodes sit comfortably either side of the thyroid cartilage [see your Laryngograph® manual for further details] and get the patient to hold the SNORS mask over their nose and mouth. Then proceed with the test, in the normal way. At the end of the test, the usual Test window appears, but there are five traces instead of the normal three (“Voicing intensity” and “Fundamental Frequency” channels are added). There will also be a Video window and a Wave window.



Analysis is carried out as for stand-alone SNORS.

If playback is used, the video image will play in real-time.

Note on video recording

Although real-time video display is in colour, recording is only possible in black and white. This is due to the extremely large size of uncompressed video files. SNORS+ does not compress video files in order to preserve the fine detail and subtle variations that are very important in videofluoroscopy images.

Due to the intense nature of video acquisition, it is normal for occasional frames to be dropped. In SNORS+, this does no affect the synchronisation of the video with the data. During playback, dropped frames are replaced with the preceding frame, so that the sequence is smooth and flicker-free. In other modes, dropped frames are blanked, so that the user can see exactly which frames are missing. Provided the acquired video sequence does not exceed the available memory (RAM), the typical frame drop rate is about 1%.

Recommended maximum recording times, at 25fps, for common amounts of memory and various image resolutions are as follows:

RAM (Mbytes)	Image Resolution	Max Recording Time
64	Low	64 s
64	Medium	16 s
64	High	4 s
128	Low	160 s
128	Medium	40 s
128	High	10 s
256	Low	288 s
256	Medium	72 s
256	High	18 s
384	Low	316 s
384	Medium	104 s
384	High	26 s

Chapter
8

Further features

How to use the extra features of SNORS+ from the menu bar

This chapter briefly describes how to use the extra SNORS+ features, which are only accessible from the menu bar.

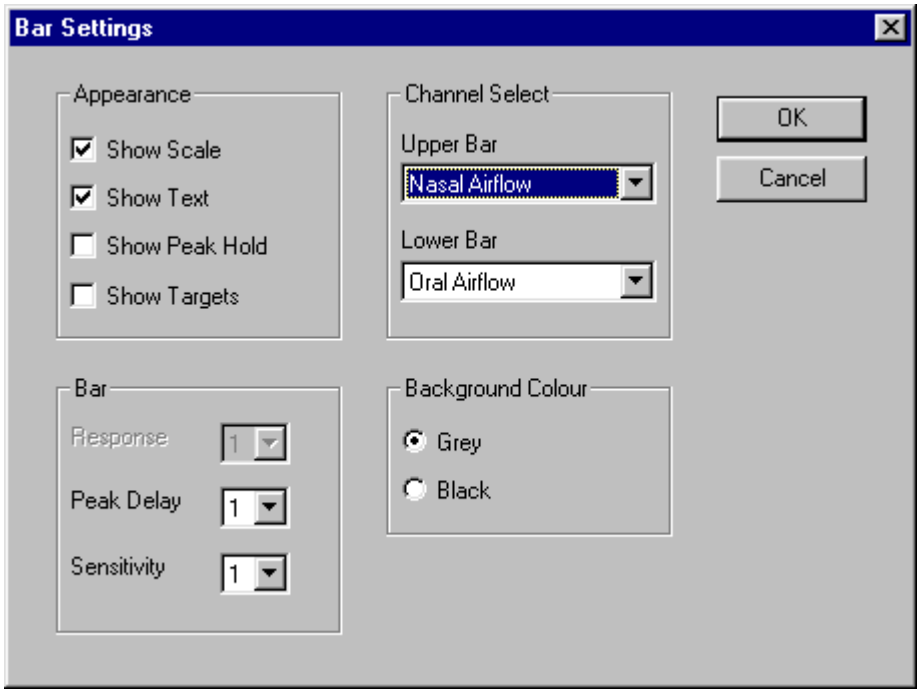
Full details of the menu bar can be found in Chapter 12.

Settings

Certain features of Bar, Scope, EPG and Wave can only be changed by selecting "Settings" from the "Options" menu. These changes can be applied to both active and saved windows.

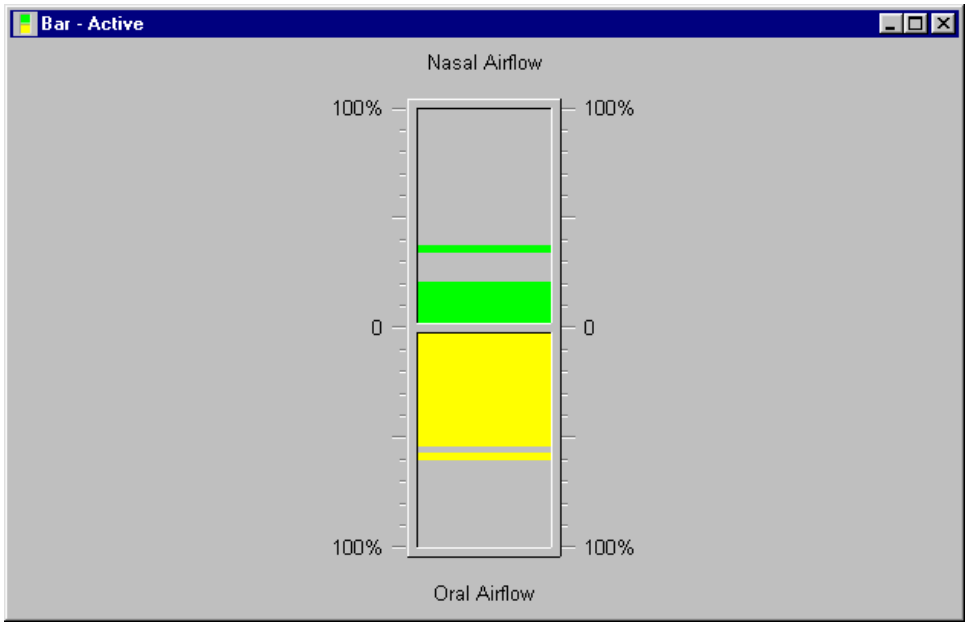
Click on "Options" on the menu bar, move down the drop-down menu until "Settings…" is highlighted, and the click on "Settings…". A "Settings" dialog box opens. The choices available depend on whether a "Bar", "Scope", "EPG" or "Wave" window is active.

Bar

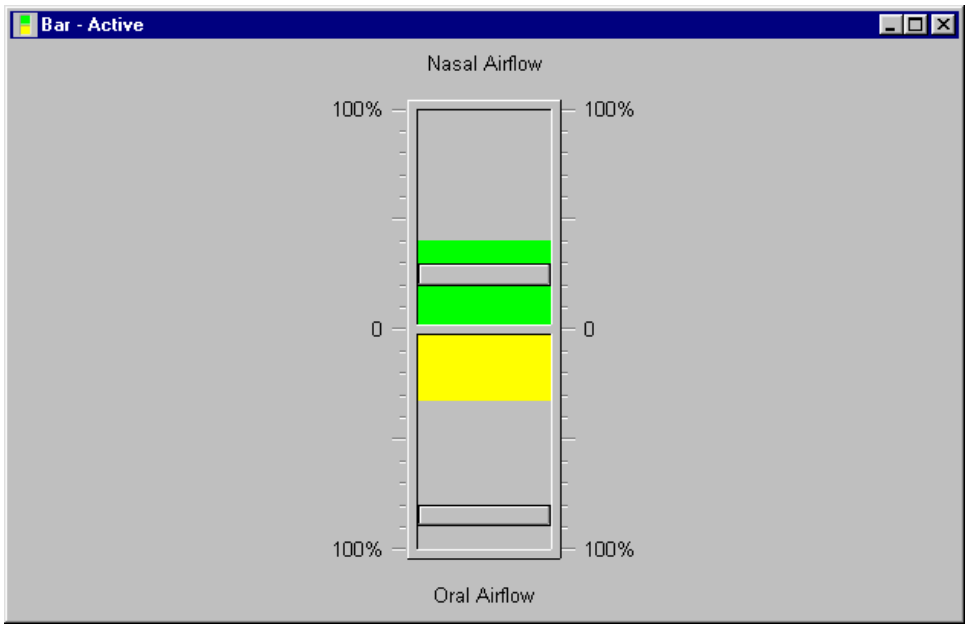


The "Appearance" box enables the "Text" and "Scale" to be turned off or on (these are on by default). In addition, "Peak Hold" indicators can be turned on. These are narrow

markers, which persist for a short time at peak values. This feature is useful for observing brief peaks of airflow.



"Targets" can also be switched on. These are user adjustable bars, which are useful for providing targets for the patient to achieve.

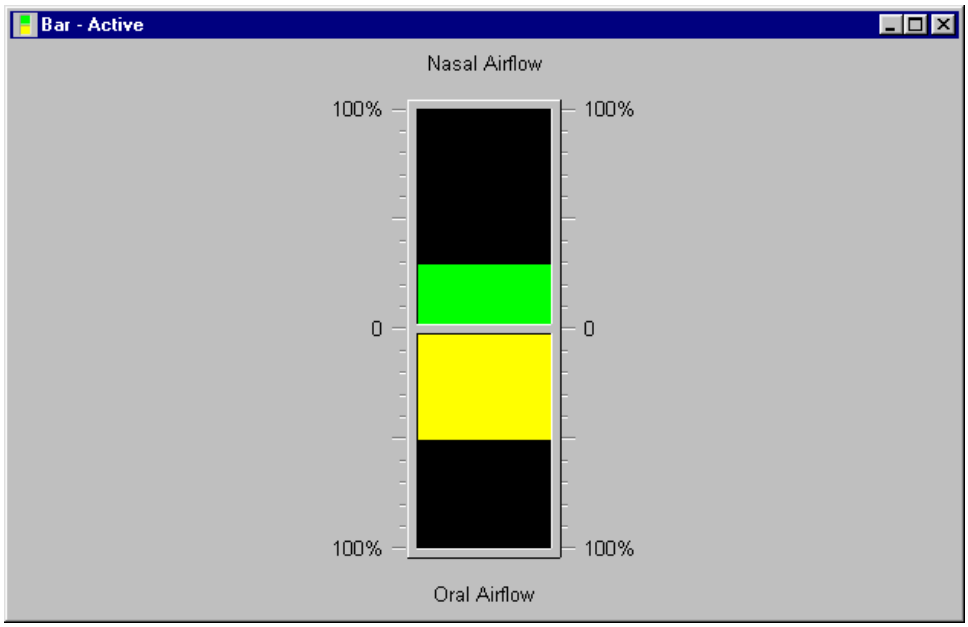


The bars are moved by placing the mouse pointer over a bar and clicking and dragging it to the required position.

The "Bar" box allows the time for which the "Peak Hold" bar persists ("Peak Delay") to be varied, by clicking on the appropriate button. The "Sensitivity" of the display can also be changed. Reducing the sensitivity has the effect of slowing down the display, which again makes it easier to observe peak values (But short-lived peaks may be lost).

"Channel Select" allows the user to alter the parameters displayed in both the upper and lower bar. For example, "Speech intensity" and "Voicing intensity" could be displayed, instead of the default "Airflow" parameters.

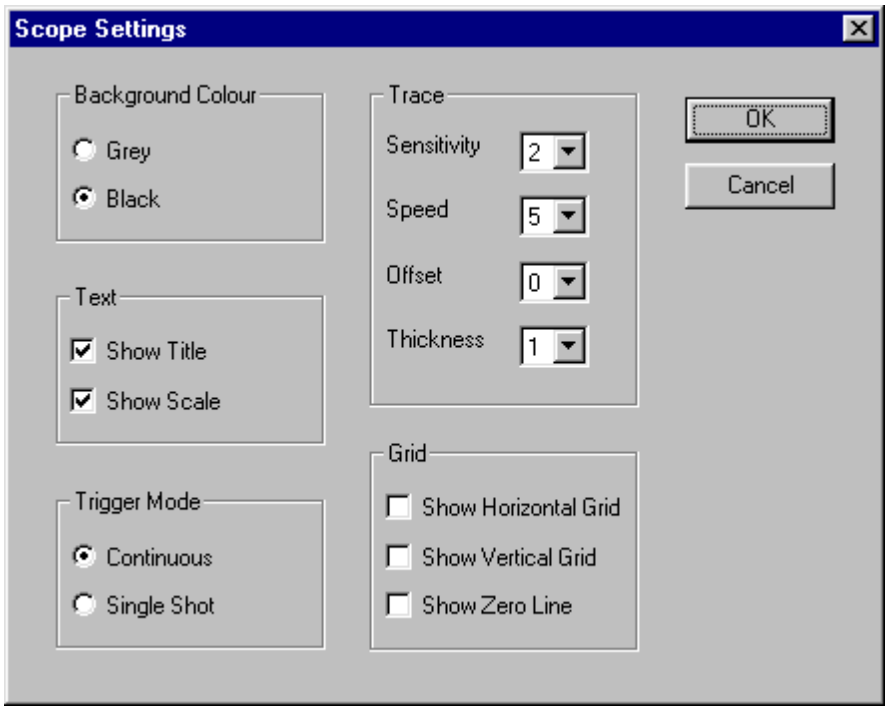
Finally, the background colour can be changed from grey to black. This provides a greater contrast, which may be useful for patients having reduced visual acuity.



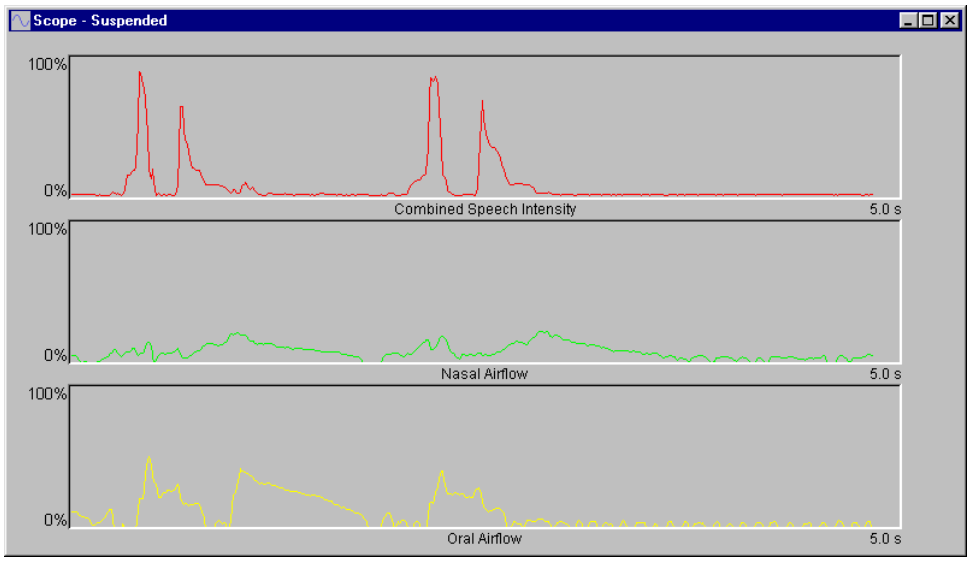
When all selections have been made, in the "Bar Settings" dialog box, they can be applied by clicking "OK", or the operation may be cancelled by clicking "Cancel".

All of the above applies equally to SNORS Bar and Laryngograph® Bar.

Scope



The scope “Background Colour” can be changed from black to grey.



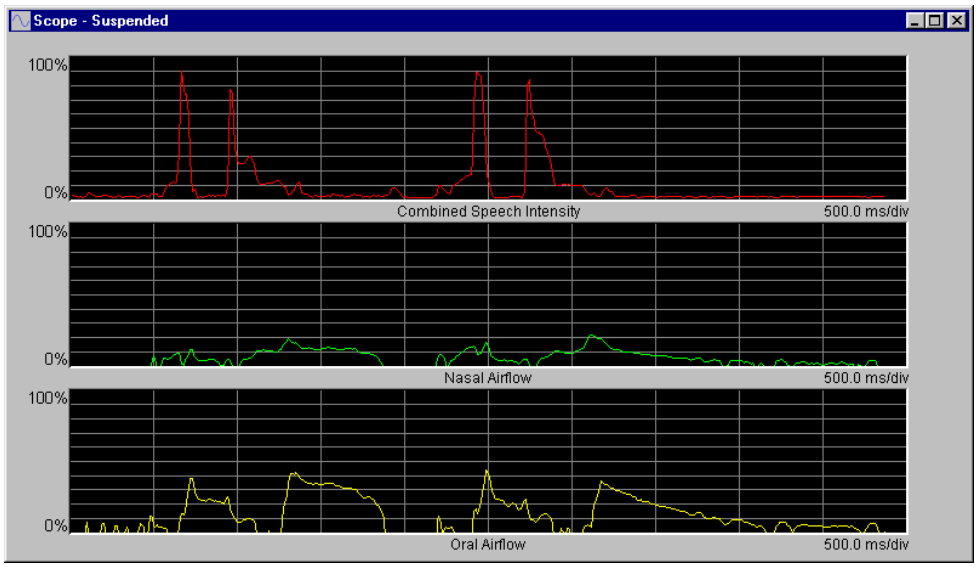
Black is the default colour for “Scope” as the relatively thin lines are easier to see against a black background.

The “Text” box enables the “Title” and “Scale” to be turned off or on (these are on by default).

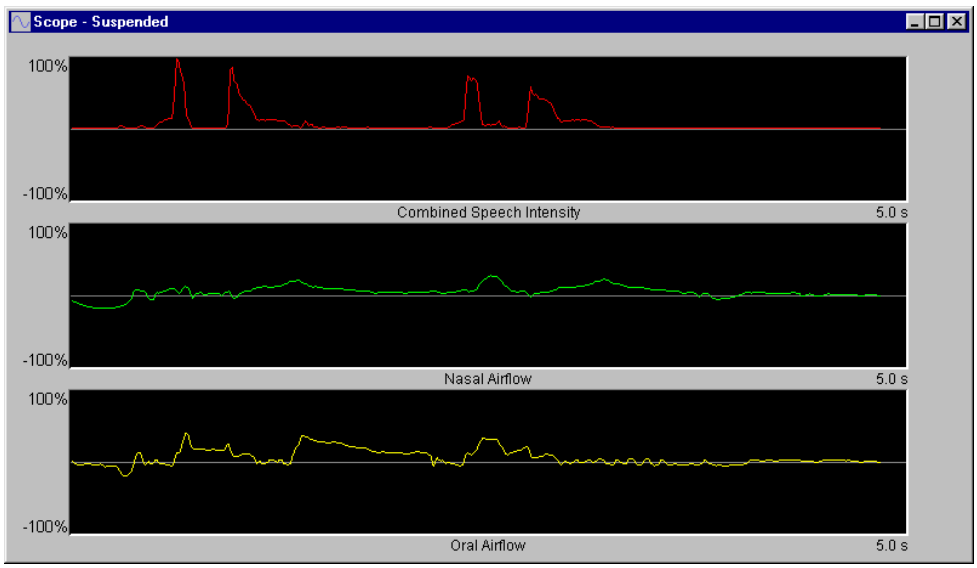
“Trigger Mode” allows the scope trace to be either “Continuous” (free running) or “Single Shot”. In single shot mode, the trace starts when the user presses any key on the keyboard and stops when it reaches the end of the screen. Pressing any key again will re-start the trace for a new, single scan. [Trigger Mode is only applicable to a real-time (therapy) window.]

The “Trace” box allows various features of the trace to be varied. Trace “Sensitivity” (gain) and “Offset” (which determines how much, if any, negative value is shown) can be adjusted, along with the thickness of the trace line, by clicking on the appropriate symbol and making a selection. [Note: an offset of 5 sets the zero at the centre of the display.] “Speed” alters the scan speed (and hence the window duration) in real-time mode.

The “Grid” box allows horizontal and/or vertical grid lines can be switched on or off.



Alternatively, a single “Zero Line” can be selected, by clicking in the appropriate selector box. This is useful when an offset has been applied and zero is no longer at the bottom of the display.

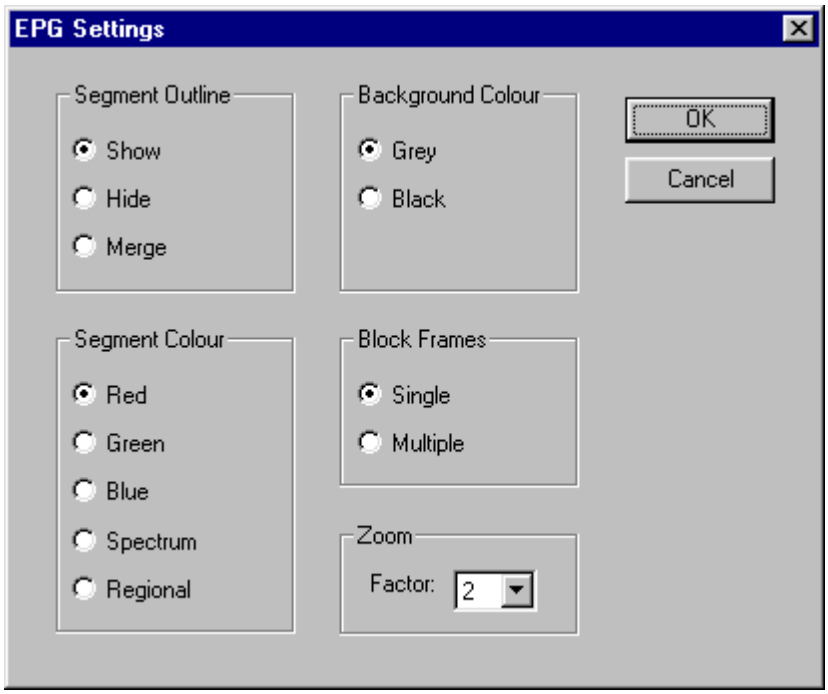


When all required selections have been made, they can be implemented by clicking “OK” or rejected by clicking “Cancel”.

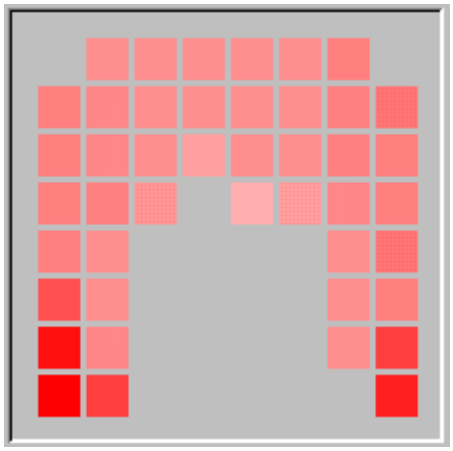
EPG

The EPG setting dialog box differs slightly in therapy and assessment modes. The assessment EPG dialog box is described first and then the differences for therapy mode are discussed.

Assessment mode

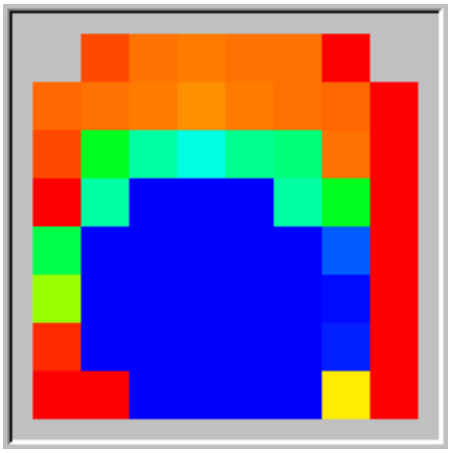


The “EPG” Settings dialog box allows the appearance of the Linguagraph EPG display to be changed. The “Segment Outline” box allows the outline boxes around each segment position to be switched on (default), by clicking “Show”, or off (as shown below), by clicking “Hide”.



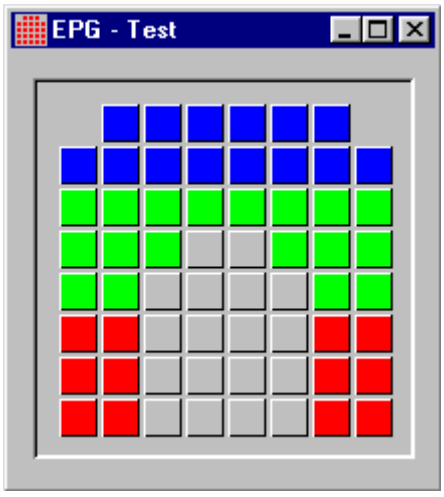
Alternatively, the segments can be enlarged, so that they merge together (“Merge”).

“Segment Colour” sets the colour of the contact display segments. Segments can be red (default), blue or green, or can be made multicolour by selecting “Spectrum”. Spectrum is useful when the block cursor is used, as colour, rather than a simple “grey scale” represents strength of contact (shown below, merged).

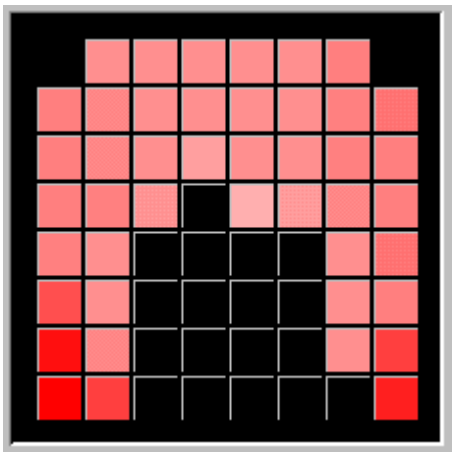


The colours are arranged as in a spectrum, with red representing maximum contact and blue representing no contact. In-between colours show varying contact strengths, in the order, red, orange, yellow, green and blue.

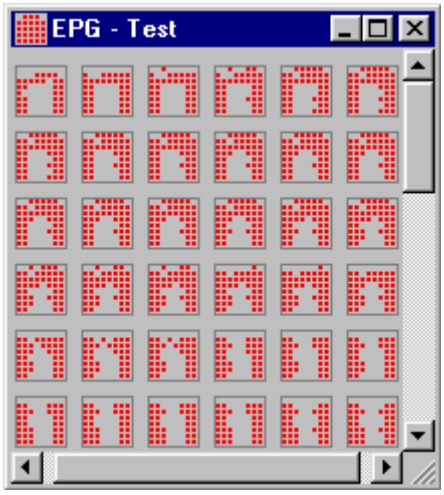
EPG segments can also be colour coded by palate region – blue for the alveolar region, green for the palatal region and red for the velar region. These colours correspond to the equivalent trace colours in Scope.



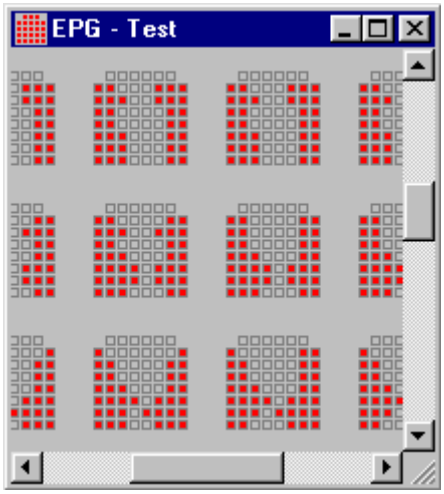
"Background Colour" sets the display background to either grey (default) or black (shown below).



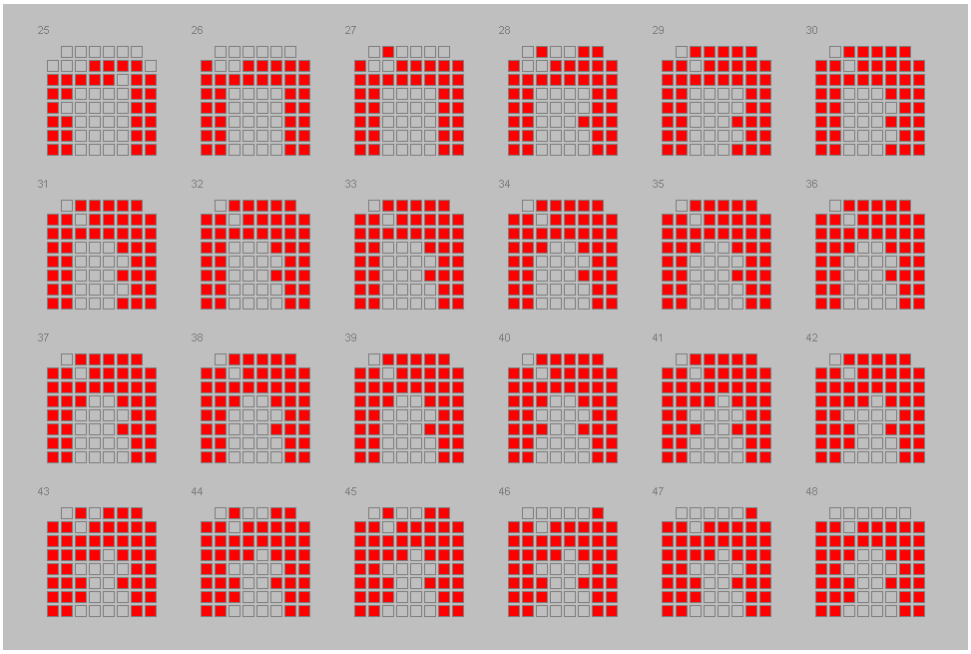
"Block Frames" selects the mode of display when a block cursor is used (in Scope). The default is to display a **Single** "grey scale" image, as shown above. Alternatively, a sequence of **Multiple** images can be displayed.



The "Zoom" control allows a part of the sequence to be enlarged.

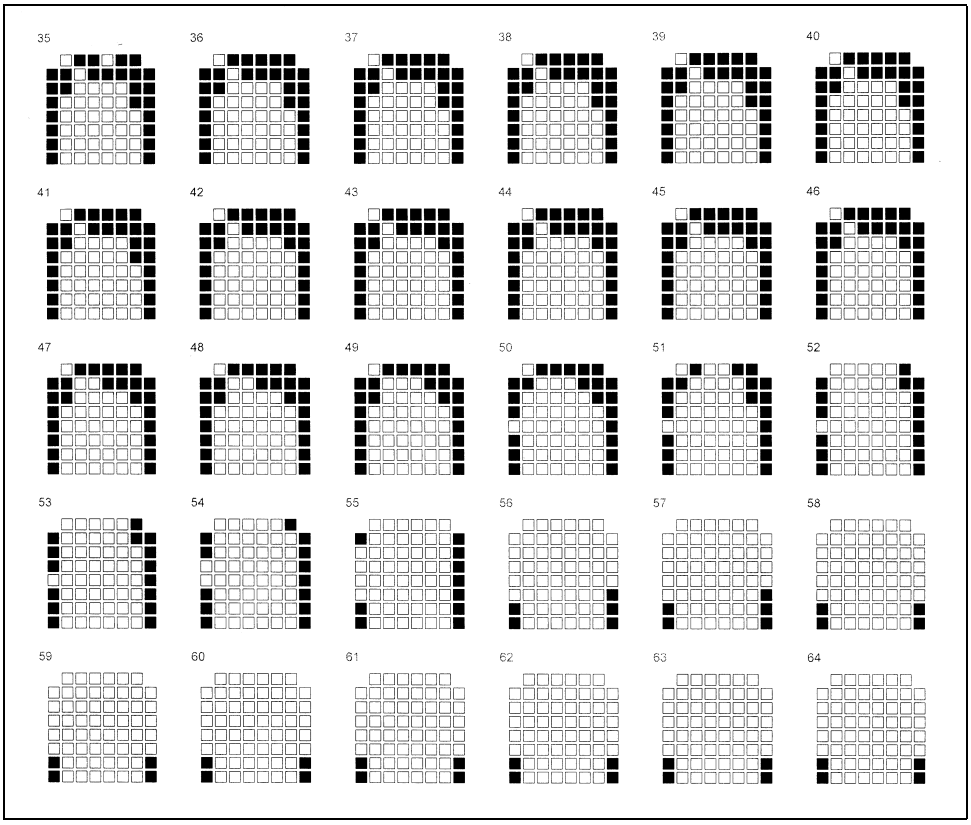


Alternatively, the EPG window can be maximised, to provide a full-screen display.

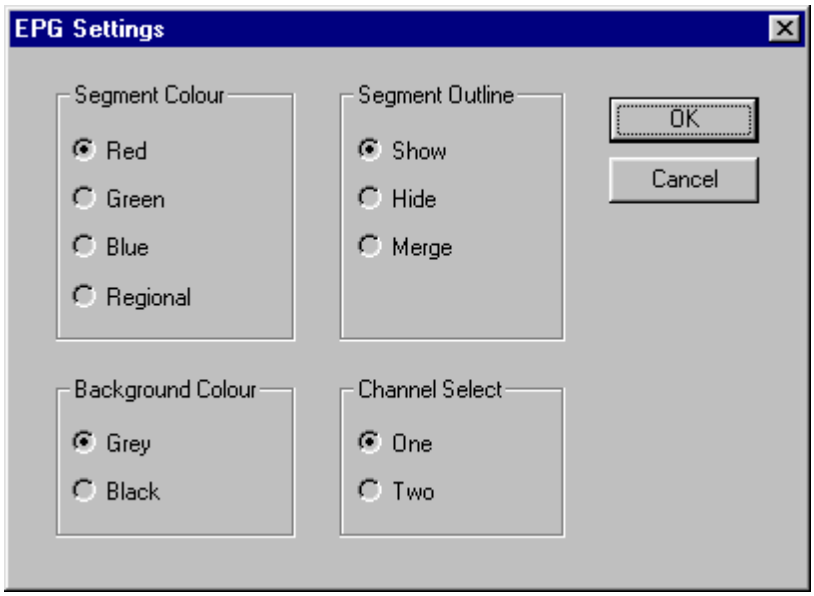


When all required selections have been made, they can be implemented by clicking “OK” or rejected by clicking “Cancel”.

“Multiple” EPG display mode is useful for providing sequential printouts. This is achieved by simply clicking in the Multiple EPG window, to make it the active window, and then clicking print on the toolbar. After making any required selections and clicking “OK” in the Print dialog box, an EPG sequence printout will be produced.

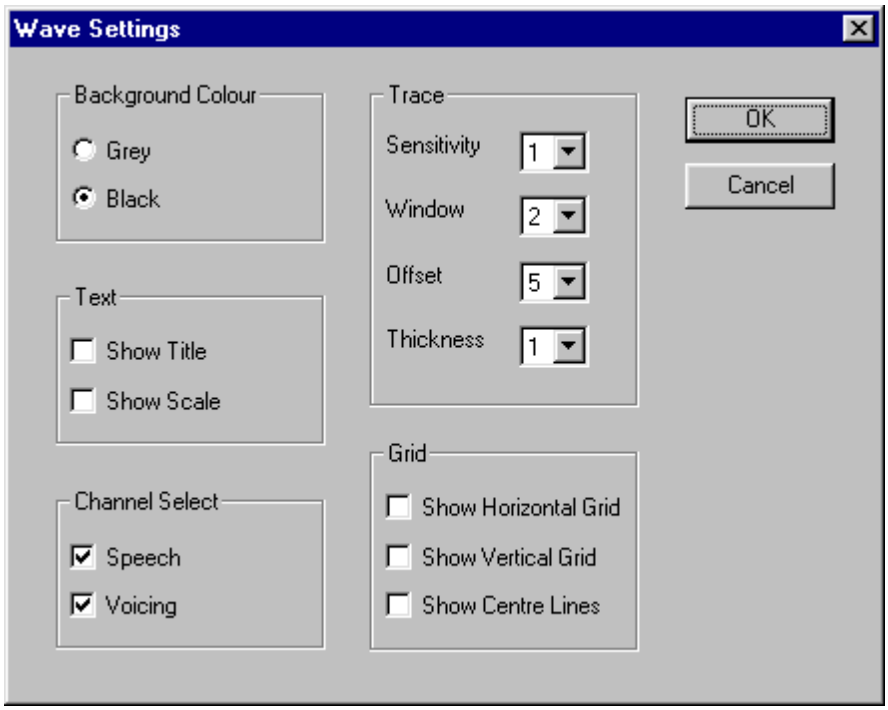


Therapy mode

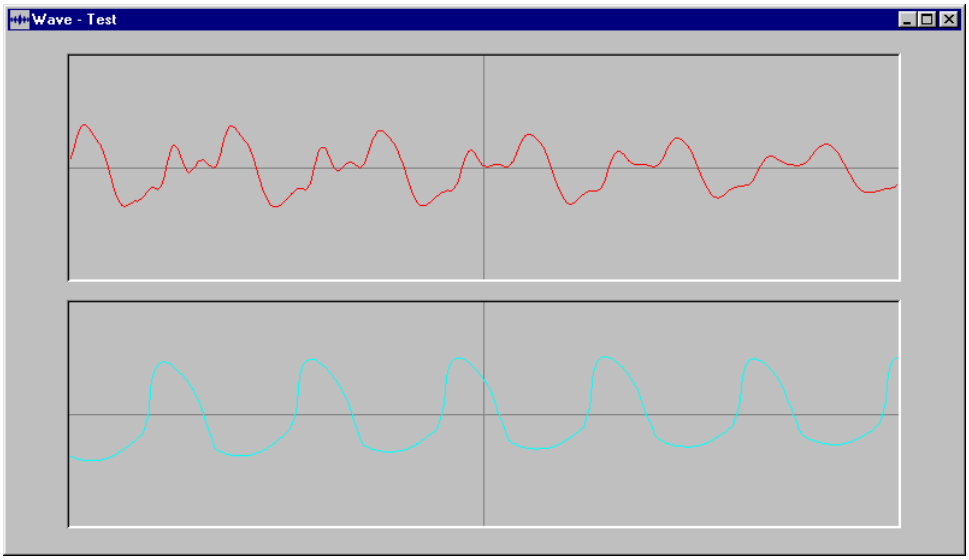


In therapy mode, the “Block Frames” and “Zoom” selections are not applicable and the “Spectrum” segment colour is not available. However, an additional “Channel Select” feature appears. This allows the active EPG window to be assigned to either Linguagraph 1 or Linguagraph 2. By default, the first active EPG window to be opened will be Linguagraph 1 and the second will be Linguagraph 2.

Wave



The Wave “Background Colour” can be changed from black to grey.



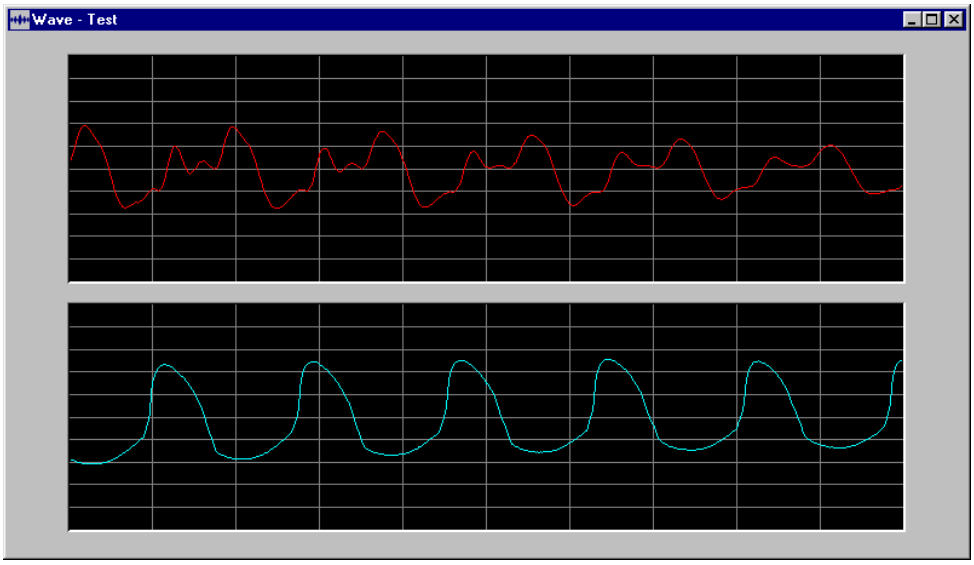
Black is the default colour for Wave as the relatively thin lines are easier to see against a black background.

"Channel Select" allows the user to choose which channels to display – Speech, Voicing, or both.

Channels are turned on or off by clicking in the appropriate selector boxes.

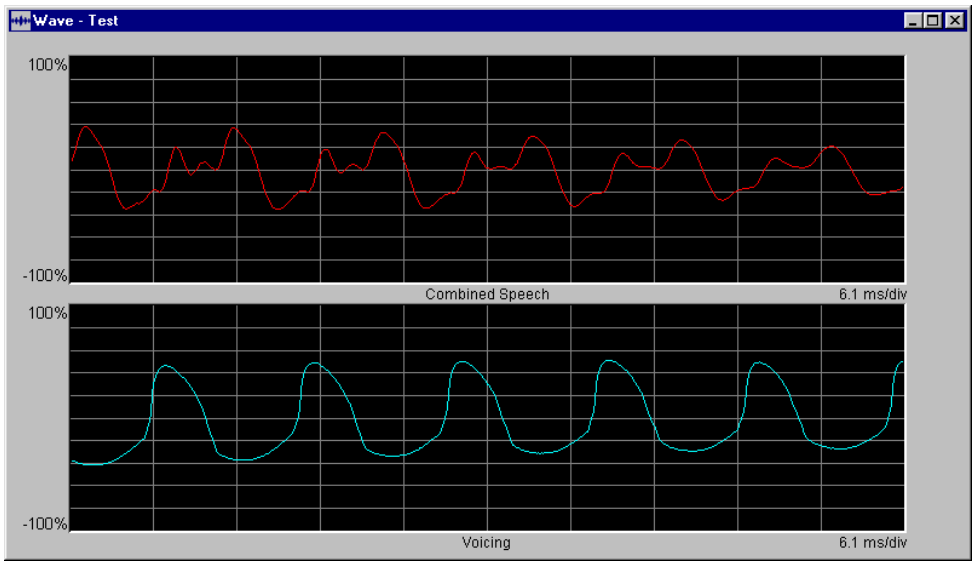
The "Trace" box allows various features of the trace to be varied. Trace "Sensitivity" (gain), Window (time duration) and "Offset" (which determines how much negative value is shown) can be adjusted, along with the thickness of the trace line, by clicking on the appropriate symbol and making a selection. [Note: an offset of 5 sets the zero at the centre of the display – default.]

The "Grid" box allows horizontal and/or vertical grid lines to be switched on or off.



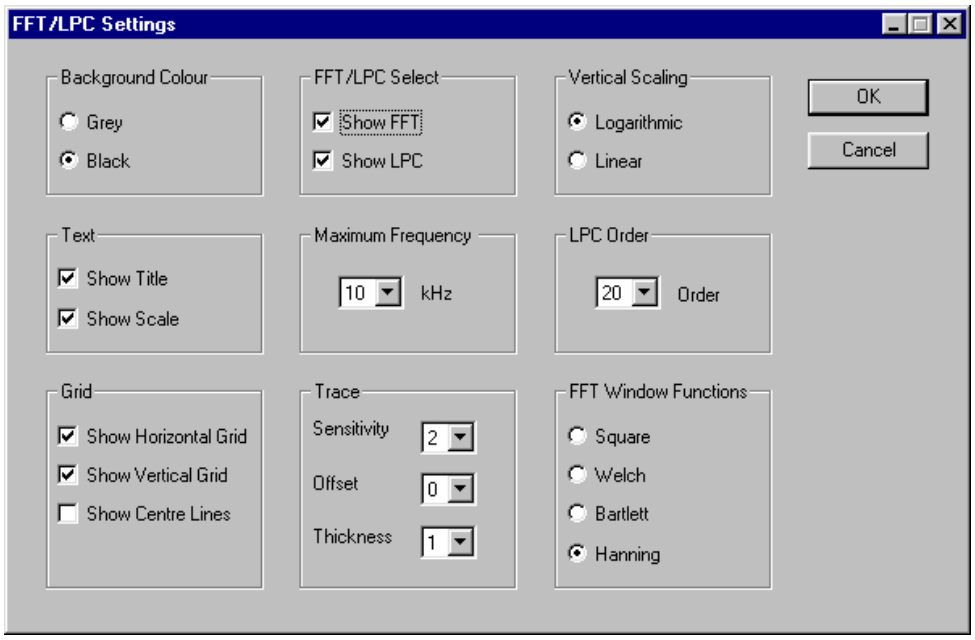
Alternatively, the default pair of horizontal and vertical "Centre Lines" can be turned on or off, by clicking in the appropriate selector box.

The "Text" box enables the "Title" and "Scale" to be turned off or on (these are on by default).

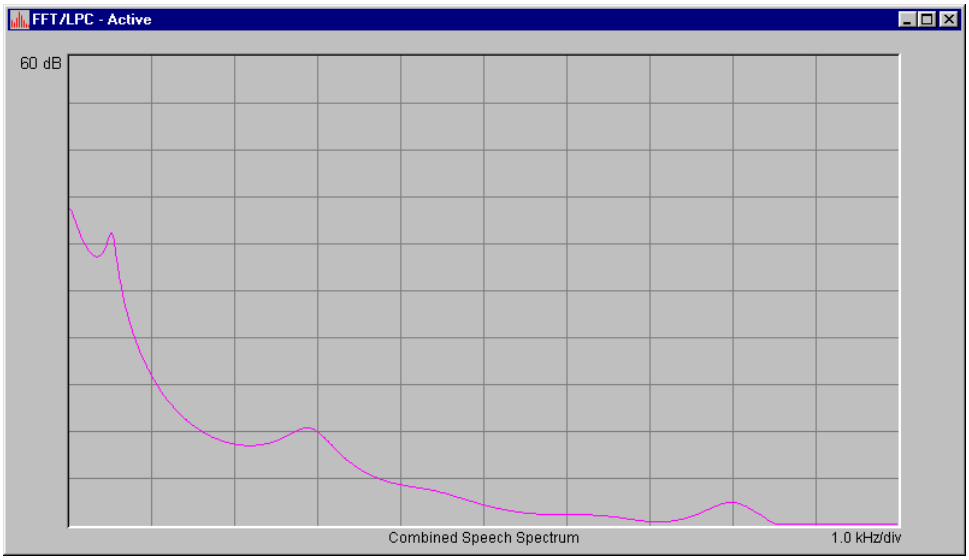


When all required selections have been made, they can be implemented by clicking “OK” or rejected by clicking “Cancel”.

FFT/LPC

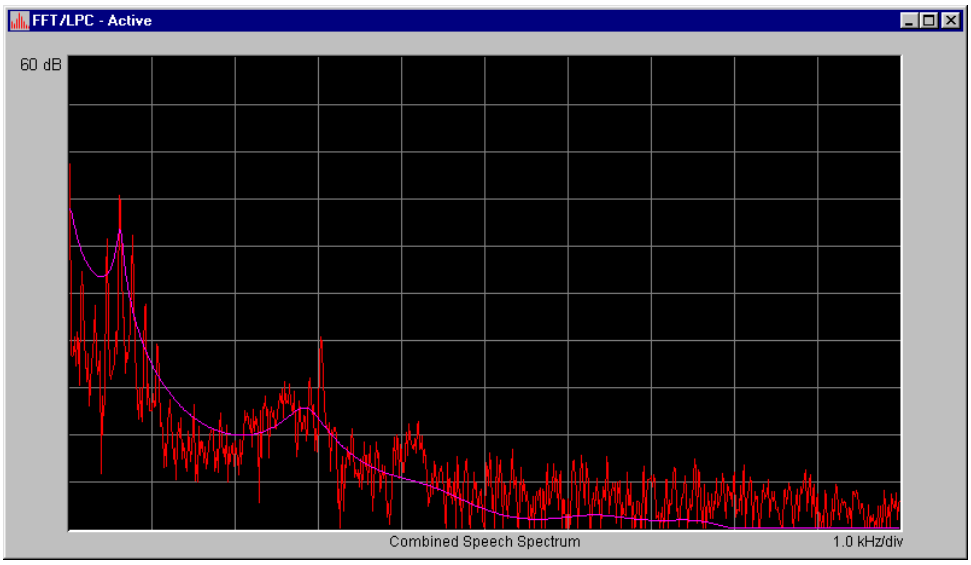


The FFT/LPC “Background Colour” can be changed from black to grey.



Black is the default colour for FFT/LPC as the relatively thin lines are easier to see against a black background.

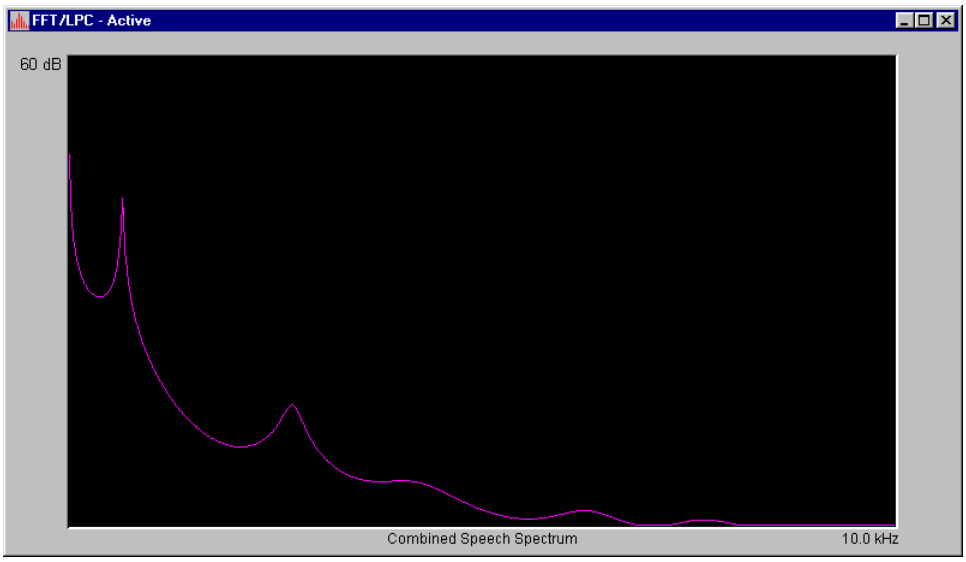
“FFT/LPC Select” allows the user to choose which plots to display – FFT (red trace), LPC (purple trace), or both. Plots are turned on or off by clicking in the appropriate selector boxes.



“Maximum Frequency” allows the user the change the frequency range that is displayed, between 1 and 10 kHz, in 1 kHz steps.

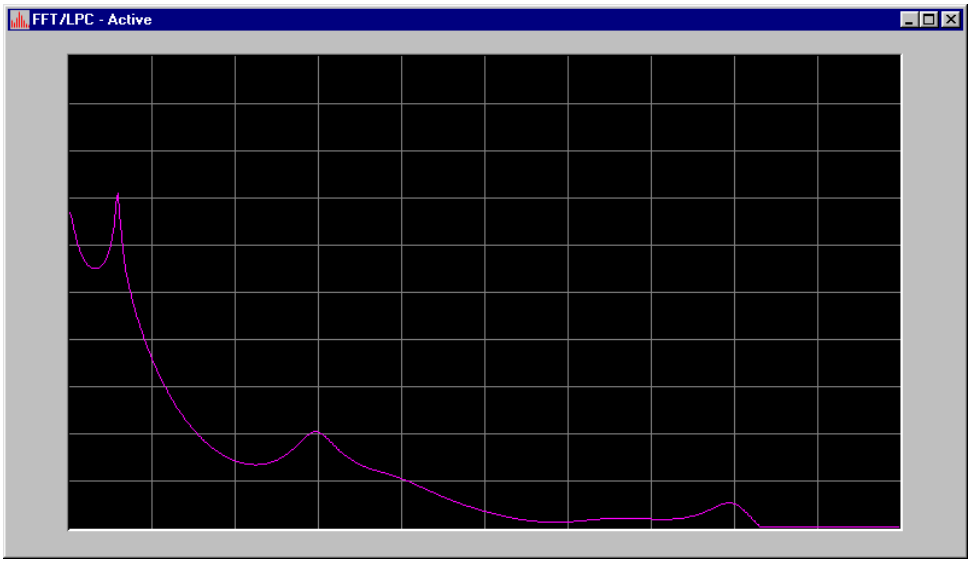
The “Trace” box allows various features of the trace to be varied. Trace “Sensitivity” (gain), Window (time duration) and “Offset” (which determines how much negative value is shown) can be adjusted, along with the thickness of the trace line, by clicking on the appropriate symbol and making a selection.

The “Grid” box allows horizontal and/or vertical grid lines to be switched on or off.



Alternatively, the default pair of horizontal and vertical “Centre Lines” can be turned on or off, by clicking in the appropriate selector box.

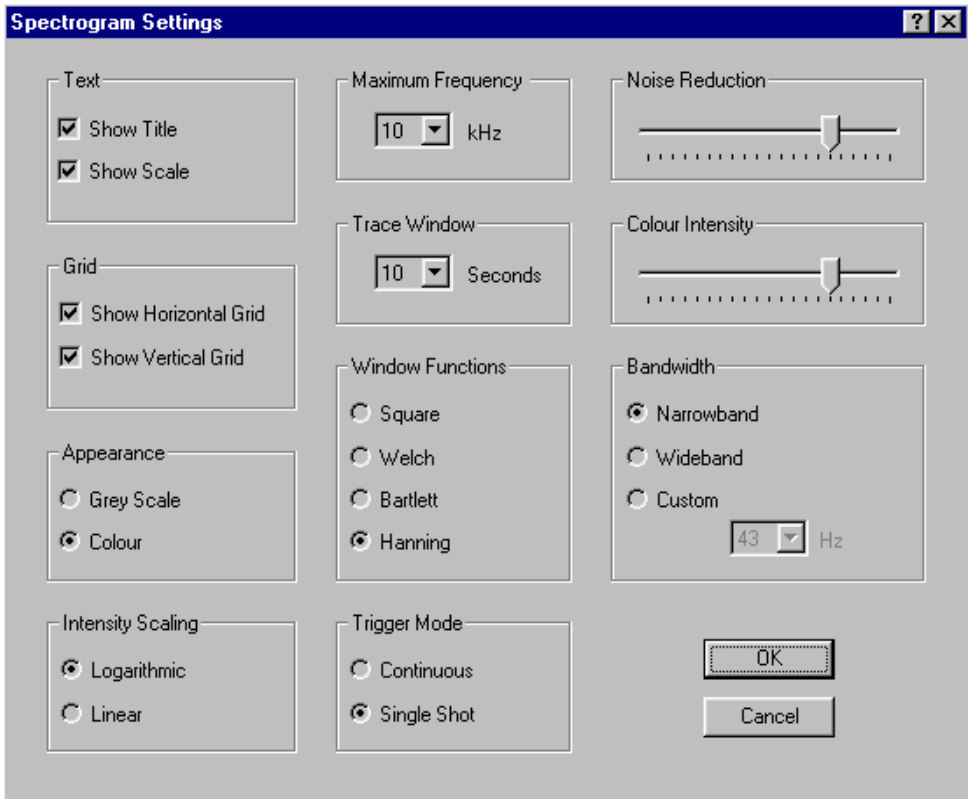
The “Text” box enables the “Title” and “Scale” to be turned off or on (these are on by default).



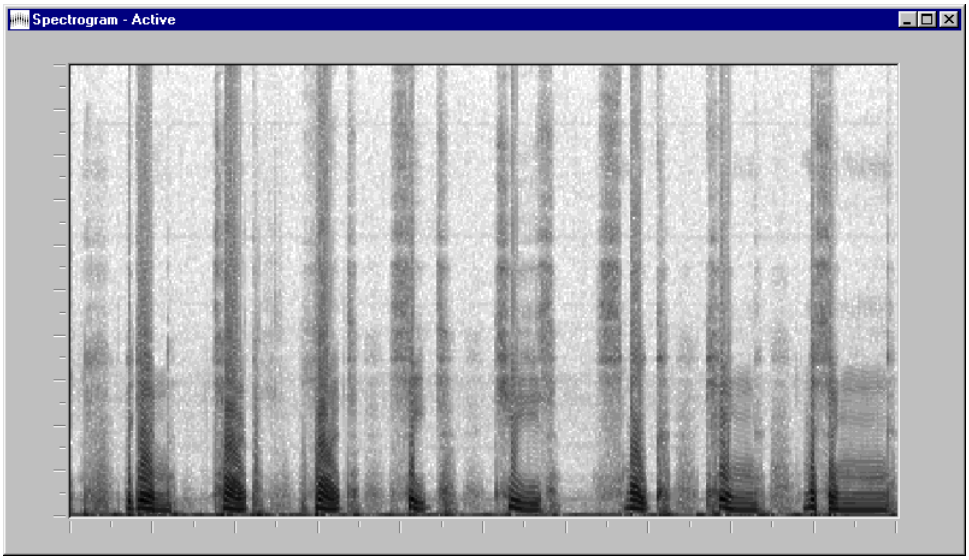
When all required selections have been made, they can be implemented by clicking “OK” or rejected by clicking “Cancel”.

[Note: other FFT/LPC display settings, which are primarily intended for research use, are discussed in Chapter 9.]

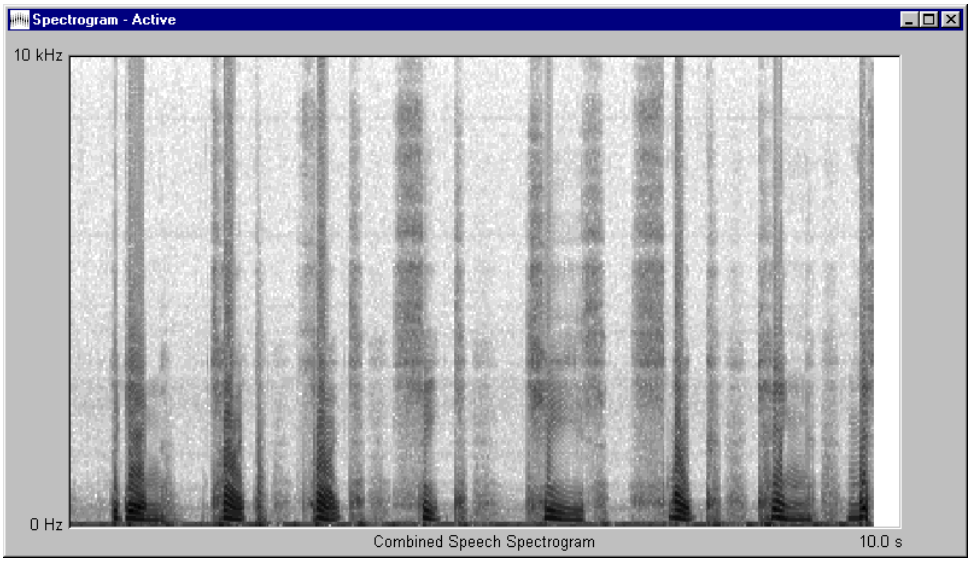
Spectrogram



The “Text” box enables the “Title” and “Scale” to be turned on or off (these are on by default).



The “Grid” box allows horizontal and/or vertical axis ticks to be switched on or off.



"Appearance" allows the spectrogram to be viewed in pseudo colour, instead of its default greyscale (see Chapter 9 for more details).

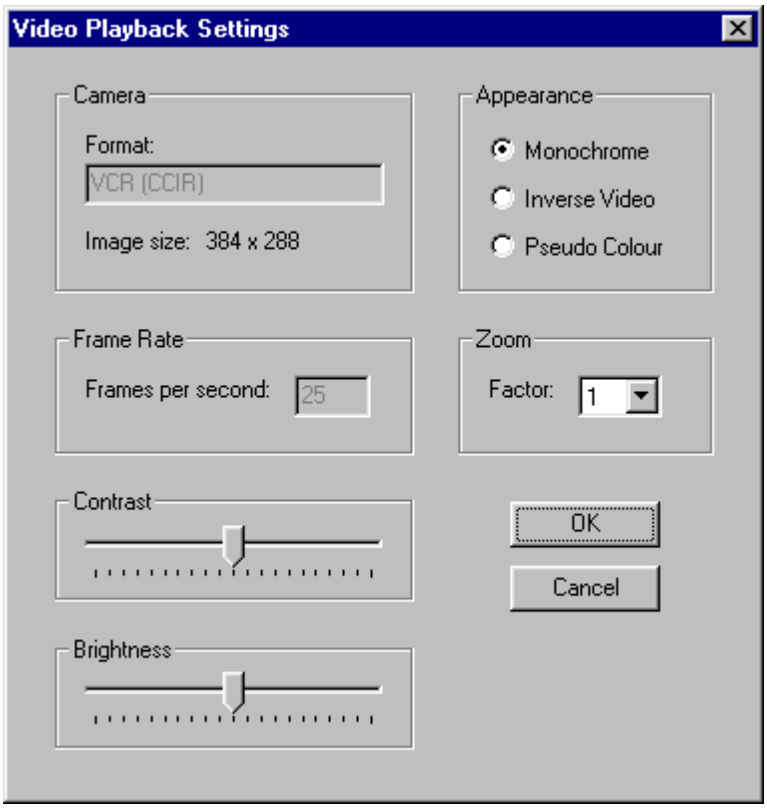
"Maximum Frequency" allows the user the change the frequency range that is displayed (between 1 and 10 kHz, in 1 kHz steps) by clicking on the symbol and making a selection.

The "Trace Window" box allows the user to change the time period displayed (between 0 and 60 seconds, in one second steps), by clicking on the symbol and making a selection.

When all required selections have been made, they can be implemented by clicking "OK" or rejected by clicking "Cancel".

[Note: other Spectrogram display settings, which are primarily intended for research use, are discussed in Chapter 9.]

Video

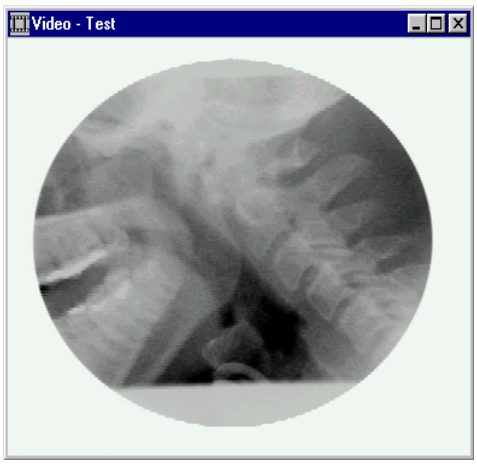


The “Camera” and “Frame Rate” boxes show the format, image size and frame rate at which the video was recorded. These are for information only, as they can not be changed retrospectively.

The “Contrast” and “Brightness” sliders can be used to alter these parameters on the displayed image. The stored image is not affected by their use. These controls operate in real-time, i.e. you can see their effect on the image as you move them.

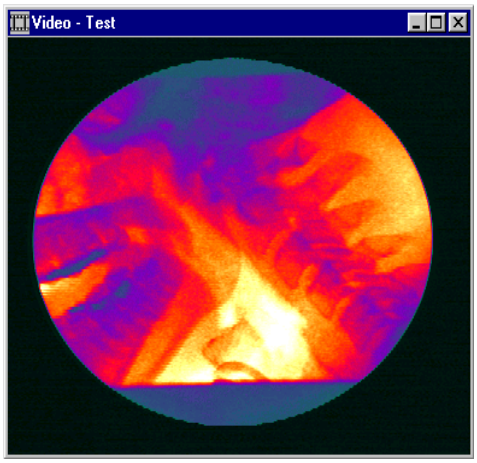
The “Appearance” box allows either standard monochrome (default), inverse video or pseudo colour to be displayed. Inverse video is useful when images are viewed by those who are more familiar with viewing film X-rays, as these appear as negatives, compared to videofluoroscopy images.

* Standard (positive) image



* Inverse (negative) image

Pseudo colour images have “false colour” applied. This sometimes makes it easier to see edges and contours.

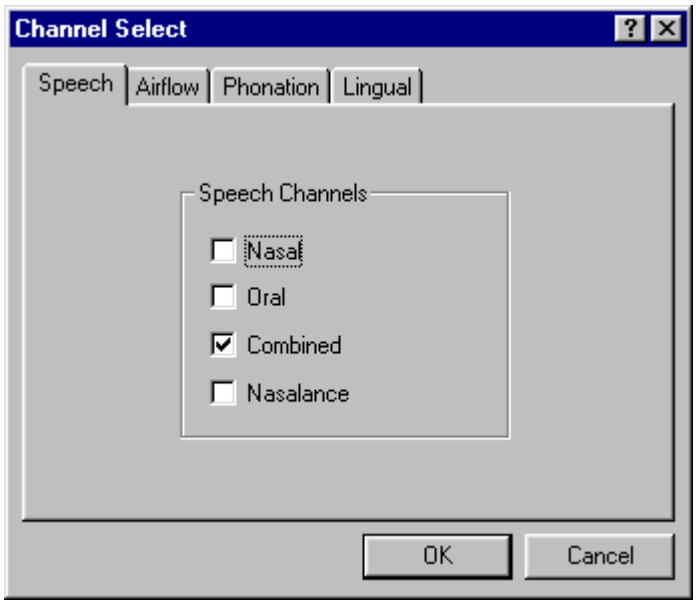


The “Zoom” selector allows the magnification of the image to be changed, i.e. it zooms-in on the image. Whenever the image is larger than the available window, scroll bars appear. These allow the portion of the image that is in view to be changed.

When all required selections have been made, they can be implemented by clicking “OK” or rejected by clicking “Cancel” (except for brightness and contrast, which are implemented in real-time.

Channel Select

When the active window is a Scope the “Options” menu also allows the various available scope trace channels to be turned on or off. Point the mouse at “Options” on the menu bar, move down the drop-down menu until “Channel Select…” is highlighted, and the click on “Channel Select…”. A “Channel Select” dialog box opens.

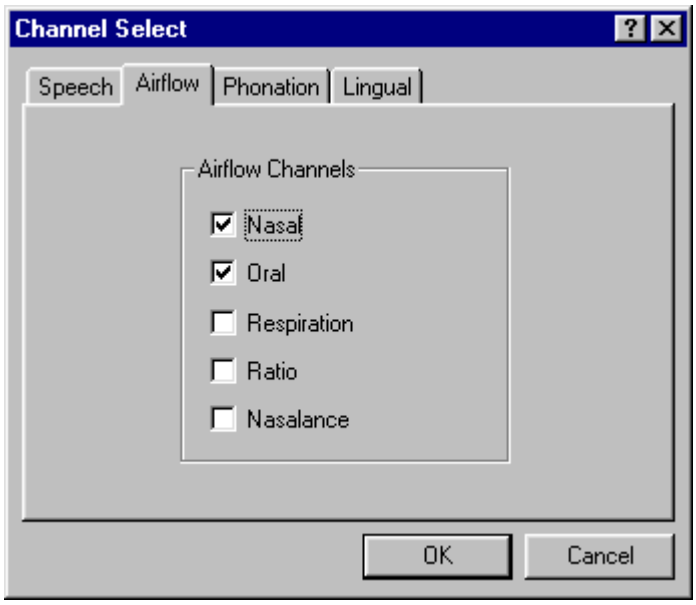


Channels are grouped on property pages by type – “Speech”, “Airflow”, “Phonation”, “Lingual” and “Aux.” (see Chapter 9 for information on the Aux. Channel). During therapy (real-time Scope), all property pages are available. However, when a previously recorded test is opened, only the property pages for those types recorded will be available. “Speech” will always be available, as this core parameter is always recorded (either from the SNORS mask or the microphone unit).

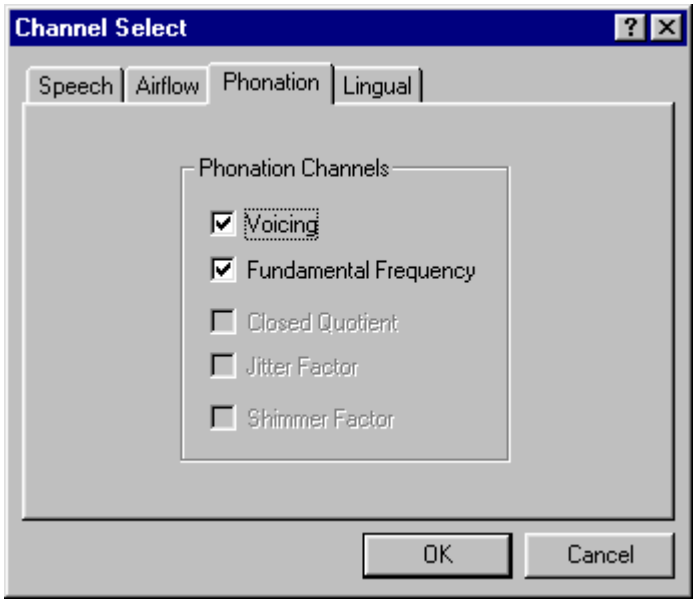
The above screenshot shows the “Speech” channels property page. Clicking in a check box switches each channel on (indicated by a tick) or off (no tick). Note that the “Nasalance” channel provided from the “Speech” property page is **acoustic** nasalance, rather than the standard (for SNORS+) aerodynamic nasalnce (which is accessible form the “Airflow” property page).

Any number of channels of any type can be on at a time, but it is recommended that no more than about six to eight be selected at once. Otherwise, the individual traces will be very small. The other main property pages are shown below.

“Airflow” channels property page:

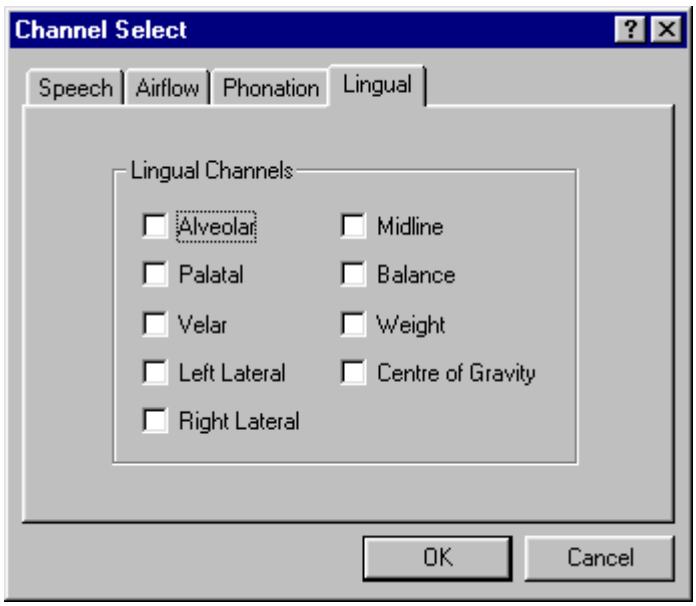


“Phonation” channels property page:



Note that three channels are greyed out on this page. In general, any channels which are not available are greyed out. In this example, Closed Quotient, Jitter Factor and Shimmer Factor are not available, as an audio recording has not been made. These parameters are derived form the high-resolution Lx waveform, which is only recorded when “Record Audio” is selected.

“Lingual” channels property page:



Test

From the menu bar, it is possible to turn various Test windows on or off. Click on "Test" and then click on the appropriate "Show" parameter.

Show Bar

Allows the Bar display to be shown or hidden.

Show EPG

Allows the EPG display to be shown or hidden.

Show Wave

Allows the Wave display to be shown or hidden.

Show Video

Allows the Video display to be shown or hidden.

Show FFT/LPC

Allows the FFT/LPC display to be shown or hidden.

Show Spectrogram

Allows the Spectrogram display to be shown or hidden.

After switching windows on or off, it is advisable to click the "Auto Arrange" button on the toolbar (or select it from the "Window" menu) to optimise the display.

The "Test" menu also allows SNORS data to be exported for use in, e.g. spreadsheets or mathematical packages. Click on "Test" from the menu bar, click "Export Data" or "Export Analysis" and then chose the required export format from the drop down box that appears.

Export Data

Provides export of the test trend signals to either the Windows Clipboard or a text file. All available Scope channels are included (whether visible or not).

Export Analysis

Provides export of the test analysis results at the current (track or Block) cursor position to either the Windows Clipboard or a text file. Analyses for all available Scope channels are included (whether visible or not).

Audio

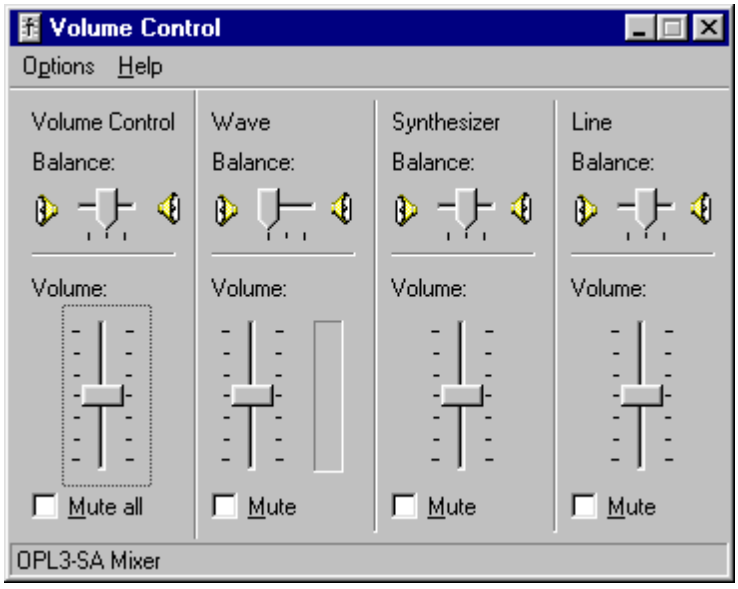
Audio features, such as playback volume, can be altered via the "Audio" menu.

Settings

Click on “Audio” on the menu bar, move down the drop-down menu until “Settings…” is highlighted, and the click on “Settings…”. A “Settings” dialog box opens.

The default quality (Radio) uses a sampling rate of 22 kHz, which should be satisfactory for most purposes. If required, the audio can be increased to CD quality (44 kHz), or reduced to Telephone quality (11 kHz). It should be noted, however, that the higher the quality, the larger the files size! A standard test **without sound** requires just 23 Kbytes of disk space. The same test with “Telephone”, “Radio” or “CD” quality sound occupies about 900 Kbytes, 1.8 Mbytes or 3.5 Mbytes, respectively.

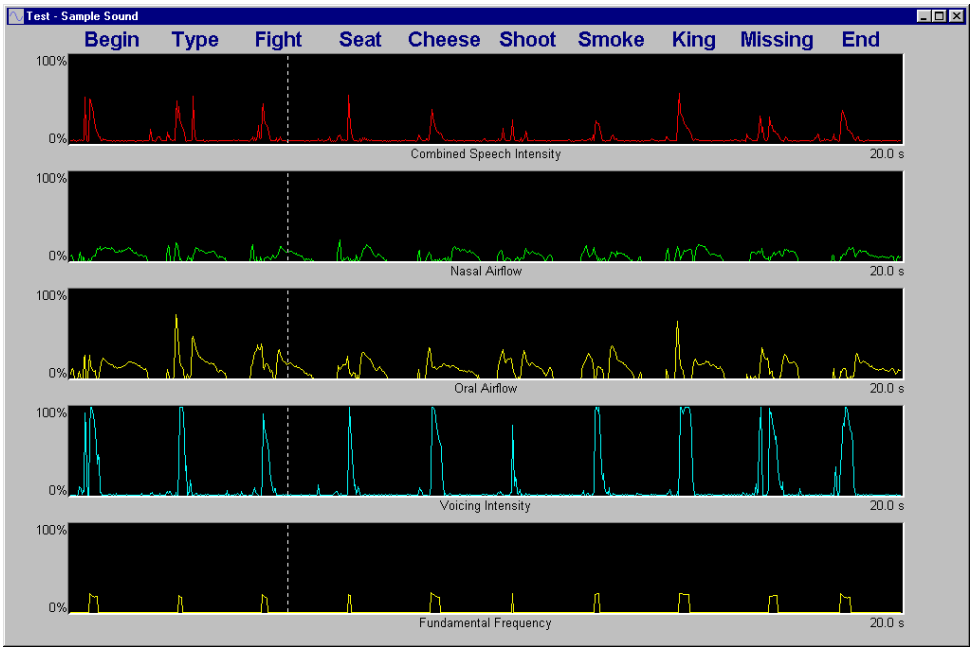
Clicking the “Advanced…” button opens the standard Windows “Volume Control” dialog box.



This allows the user to alter the playback volume, using the “Volume Control” and/or “Wave” “Volume” sliders. It is also possible to listen to the Laryngograph® Lx signal, by moving the “Wave” “Balance” slider to the right. This signal, which represents voicing, will be heard as a buzz.

Show Animation cursor

Clicking this menu item turns the animation cursor on and off. The animation cursor is a dotted vertical line (shown below).



Window

The "Window" menu function allows the open windows to be arranged in various ways. All standard Windows 95/98® functions are provided (see your Windows 95/98® user manual) plus a custom function – "Auto Arrange". In most cases, "Auto Arrange" will provide the best window arrangement. [Note that "Auto Arrange" is readily accessible from the toolbar.]

Cascade

Displays all open windows as a cascade.

Tile horizontal

Arranges all open windows horizontally.

Tile vertical

Arranges all open windows vertically.

Auto Arrange

Automatically arranges all open windows.

Arrange Icons

Automatically arranges any iconised windows.

Close All

Closes all open windows.

1, 2, 3, etc

Switches between different windows.

Help

The “Help” menu item provides help about SNORS+, in the standard Windows 95/98® manner. See your Windows 95/98® manual for full details on using the help system.

Contents

Displays the table of contents for the help system.

Search

Searches the help system for the specified topic.

Using help

Displays information about using the help system.

About...

Provides basic information about the SNORS+ program, including version number, licensed user, and copyright details.

Chapter
9

Research Features

Advanced features, aimed primarily at researchers

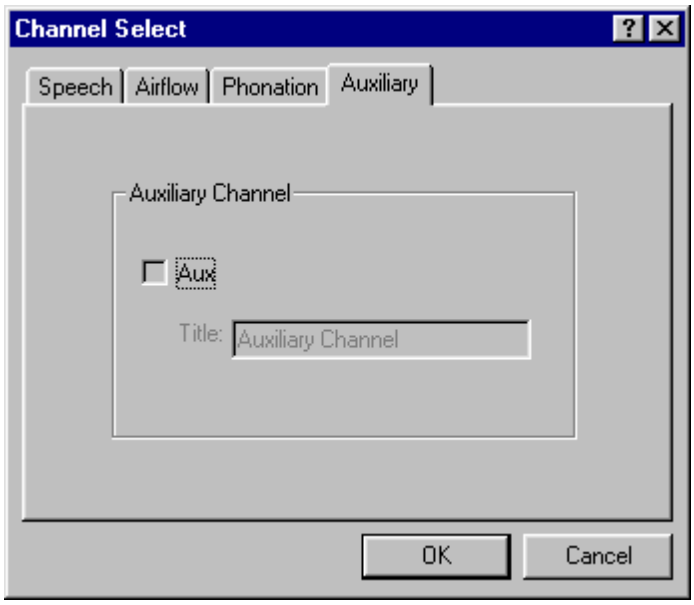
This chapter describes the advanced features provided in SNORS+, which are mostly useful for research purposes.

Auxiliary input

SNORS+ provides an auxiliary input (Aux.), which may be connected to any suitable instrument. This allows simultaneous capture of data from the instrument.

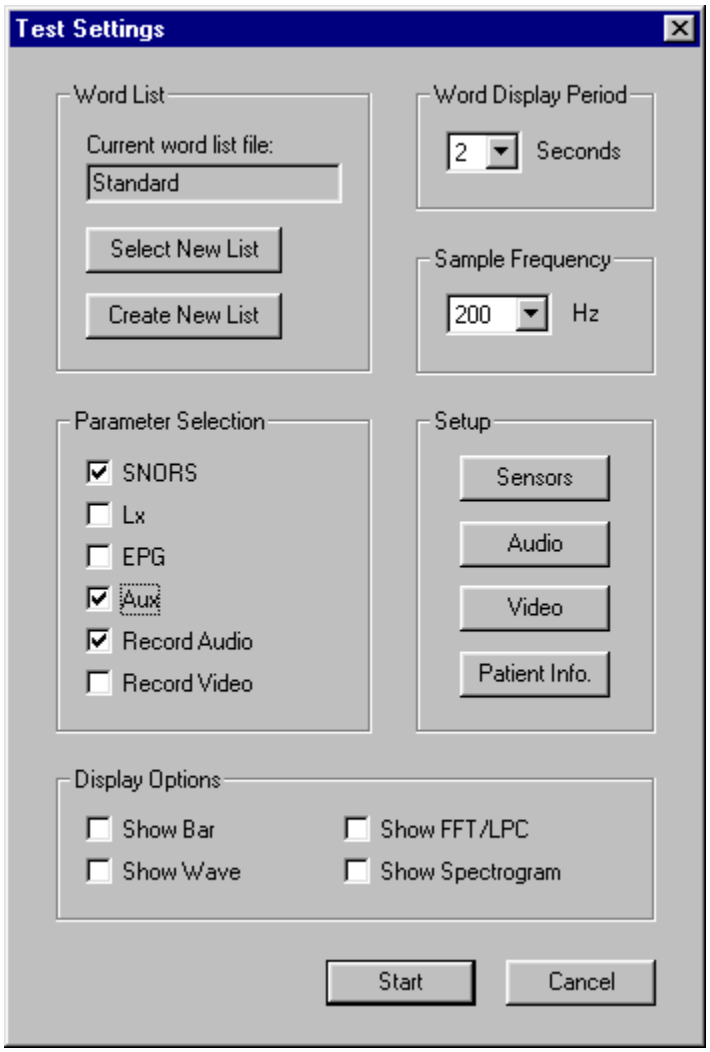
Connection to the Aux. input is via a BNC connector on the rear panel of the SNORS+ Base Unit. The input signal voltage range is set at ± 2.5 V.

The title used for the Aux. input is user-definable, via the "Auxiliary" property page of the "Channel Select" section of the "Options" menu. [Note that the "Aux" box must be checked *before* the title can be entered.]



Aux. behaves just like any other input channel on SNORS+. Hence, it can be used as one parameter of a Bar display or as a channel of a Scope display. Its gain, offset and line thickness will vary along with the other channels, as selected.

When performing a Test, the Aux. Channel is selected by chicking its box on the Test Setting dialg box, just like selecting any other parameter.



The title for the Aux. channel can be changed using the “Auxiliary” property page of the “Channel Select” section of the “Options” menu, as above. This should be done before the Test is saved, so that the chosen title is saved with the test results.

High resolution mode

In normal use, SNORS+ limits the bandwidth of its input signals (except for the “high resolution” signals recorded via the soundcard, when “Record Audio” is selected). This has two advantages for clinical use:

- Lower samples rates can be used, resulting in smaller data files.
- Displays are simpler and less cluttered.

The way that this is achieved is as follows.

The speech signal is envelope detected and then low-pass filtered. This provides a display that represents the instantaneous peak values of the speech waveform, i.e. the speech intensity.

The airflow signals are simply low-pass filtered. This removes the periodic fluctuations resulting from voicing, while displaying the lower frequency variations in airflow caused by the other articulators (the tongue and the velum).

For research purposes, it is sometimes useful to be able to see the flow variations resulting from voicing. In addition, a higher bandwidth may be needed for the auxiliary channel. SNORS+ allows the band limiting to be removed, by switching from lo- to hi-resolution mode. This is achieved by means of a small switch, located on the rear panel of the Base Unit. The switch is deliberately small, to avoid accidental switching into hi-res mode.

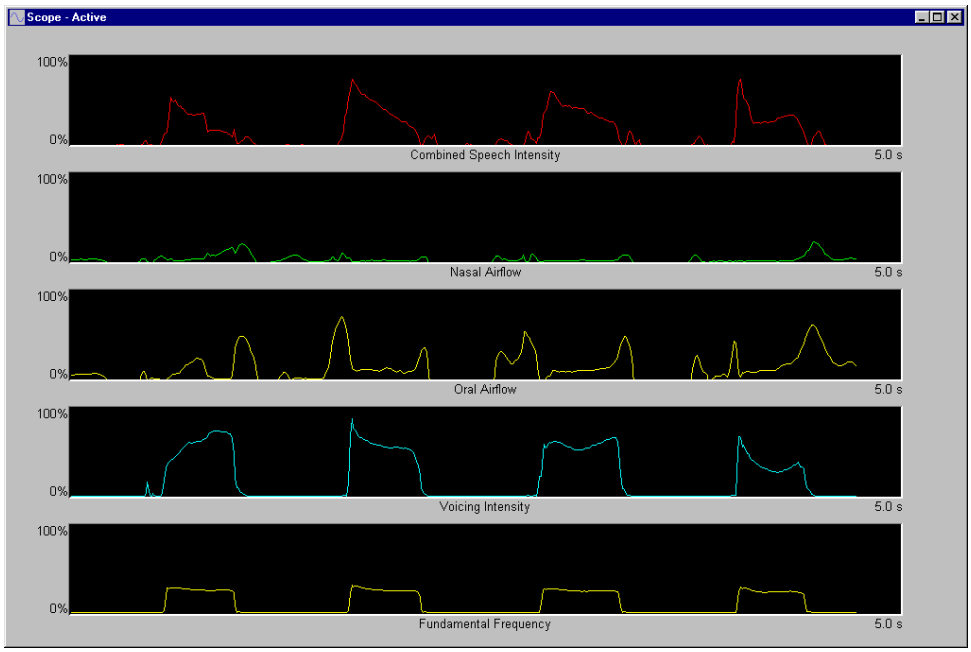
Operation of the switch is automatically detected by the SNORS+ software. The following changes will occur when the switch is moved from its lo-res to hi-res position:

- **Speech intensity** will change to **Speech**.
- **Voicing intensity** will change to **Voicing**.
- **Airflow** will change to **Unfiltered Airflow**.
- The default sampling rate will increase.
- Scope traces will default to Bipolar, instead of Unipolar.

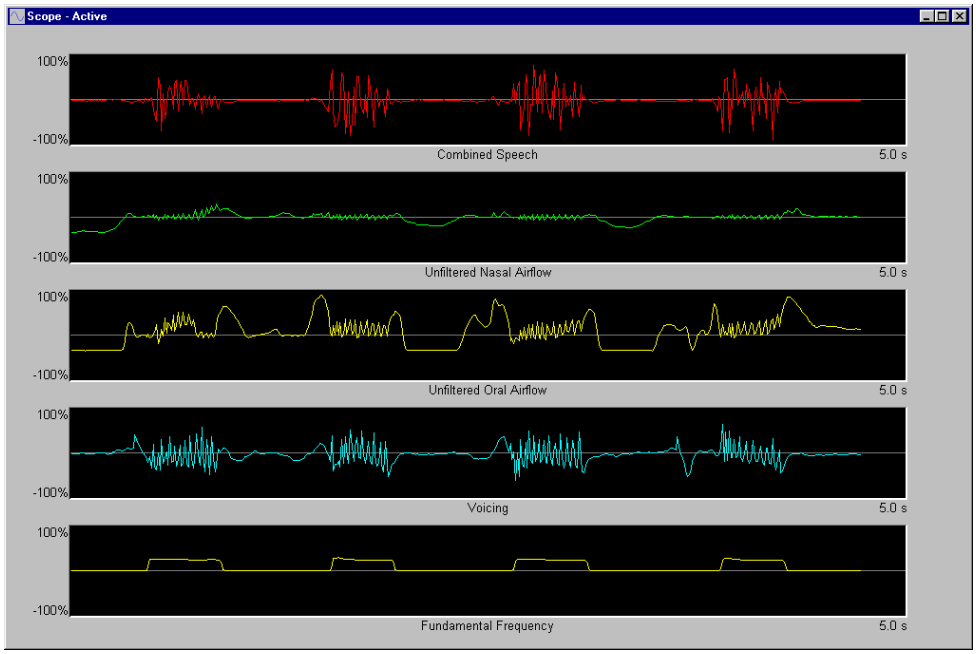
The switch can be operated at any time. Note, however, that if the switch is changed while a Scope window is active, although the trace will instantly change, the axes will not. The axes are set when a Scope window is opened. Hence, it is necessary to close and re-open the Scope window to change the axes.

Examples Lo-res (standard) and Hi-res displays are given overleaf.

Lo-res display



Hi-res display

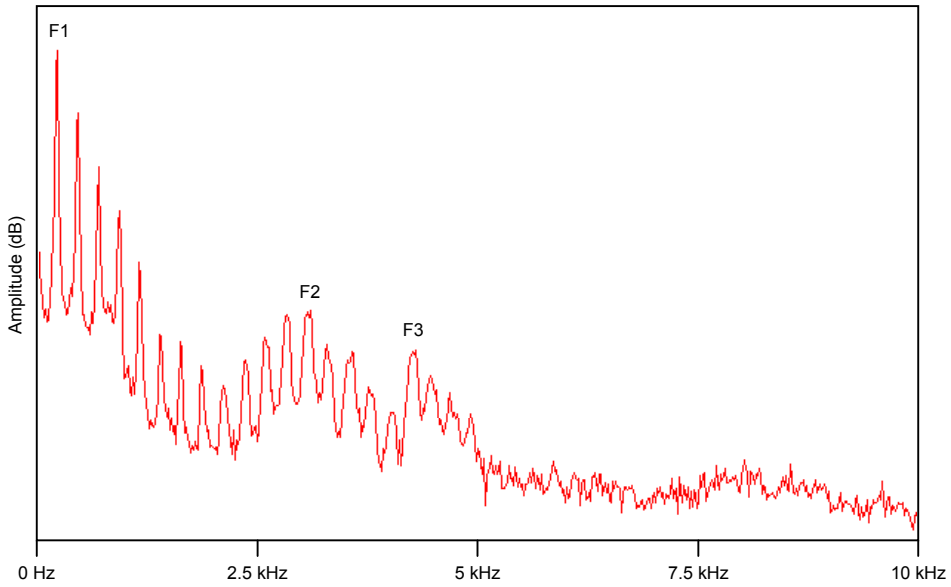


Note: when using Hi-res mode, screen aliasing can occur. This is because the resolution of the screen is not sufficient to display enough data points to satisfy the sampling law. By zooming into a small portion of the display, this problem can be overcome – providing the selected sampling rate was high enough to meet the Nyquist criterion (sampling frequency must be at least twice the highest frequency component of the signal).

Frequency Domain Analysis – FFT's, LPC's and Spectrograms

The Fast Fourier Transform

A Fast Fourier Transform (FFT) is based on the theorem that complex periodic waveforms can be decomposed into a series of sinusoidal components of certain amplitude and phase. Each sinusoidal component derived from a complex periodic waveform is an integer multiple of the fundamental frequency. Fourier's theorem permits the transformation of a waveform into a spectrum where the amplitude of each component frequency is represented. On a typical FFT display, the frequency components are plotted on the x-axis and their relative amplitude on the y-axis. The importance of this theorem for speech analysis is its ability to extract the fundamental frequency and associated harmonics, together with an approximation of the vocal tract resonances. The figure below illustrates an FFT derived from the utterance 'king'.



* FFT derived from the utterance 'king'

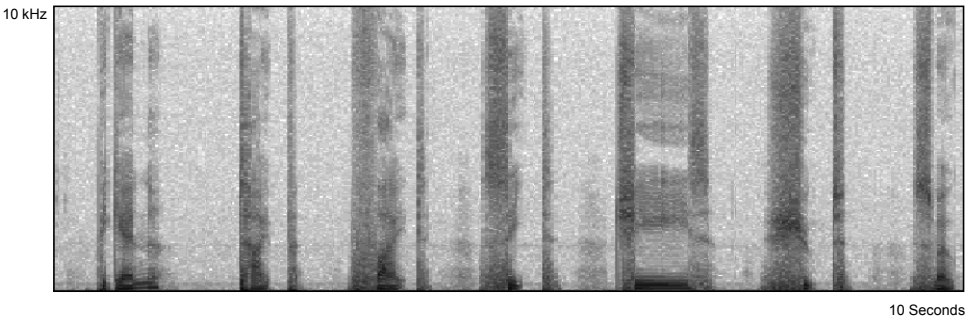
The sharp spectral peaks evident in the figure represent the harmonics of the fundamental frequency that are associated with vocal fold vibration (phonation). However, some spectral peaks have greater amplitude than others do since they lie near a vocal tract resonance, which further amplifies these frequencies. The regions of the spectrum where a group of harmonics exhibits relatively greater amplitude are known as formants, and are labelled F1, F2 and F3 in the figure. It should also be noted that the formant structure appears to break down above 5 kHz as the noise introduced by turbulent airflow through the vocal tract begins to dominate.

Further information on the FFT are given in the next section (Spectrograms).

Although FFT's yield useful information relating to fundamental frequency and the resonant frequencies of the vocal tract, they provide no information on how these frequencies change with time.

Spectrograms

A sound spectrogram is a visual representation of an acoustic signal. It is created by applying a Fast Fourier Transform to the sampled acoustic signal, where it is separated into sinusoidal waveforms of different frequency. These frequencies are represented vertically on the spectrogram with time plotted horizontally. Energy, or loudness, is depicted by grey scale intensities as shown below.

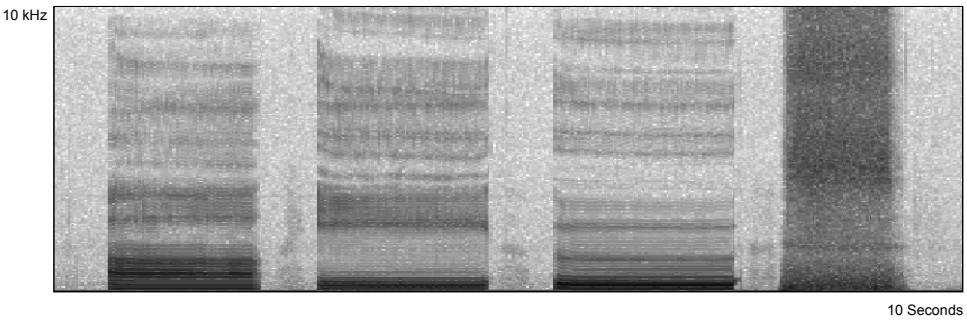


* A narrowband spectrogram of the utterance: “Begin”, “Type”, “Fight”, “Seat”, “Cheese”, “Smoke”, “King”

It is the spectrogram’s ability to display the rapid variations in the acoustic signal, which makes it such a valued instrument. Spectrograms provide analysis of the frequency components of the acoustic signal, either in terms of the harmonics it comprises or of the peaks of resonance (formants) that it contains. The relative degree of darkness also conveys information about the signal strength. Generally, two forms of the spectrogram are used, namely wideband and narrowband.

Narrowband Spectrograms

These are useful for making measurements on fundamental frequency and intonation. A prominent characteristic of the narrowband spectrogram is the narrow horizontal bands, which represent the harmonics of the glottal source, see below. The darker bands represent harmonics that are closest to the peaks of resonance in the vocal tract. The lighter bands represent harmonics whose frequencies are further away from the resonance peaks. Narrowband spectrograms exhibit good frequency resolution at the expense of time resolution and are therefore not suitable for making temporal measurements such as voice onset time. The actual bandwidth of this type of spectrogram is usually somewhere between 30 and 50 Hz.

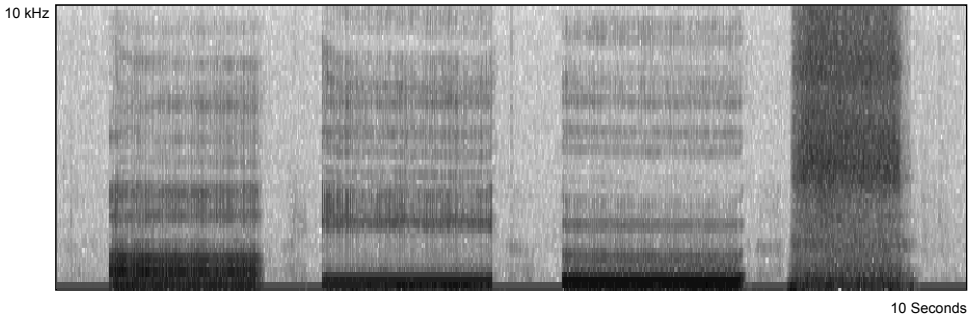


* A narrowband spectrogram of the utterance /ɛɪ/, /i/, /ʊ /, /ʃ/

Wideband Spectrograms

Measurements of the changing resonance of the vocal tract (formants) are generally made with this type of spectrogram. The most noticeable feature of the wideband spectrogram is the relatively broad bands of energy that depict the formants (see below). The centre of each energy band is taken to be the frequency of the formant

and the range of frequencies occupied by the band is taken to be the bandwidth. Although adjacent harmonics may appear smeared together, wideband spectrograms do exhibit good time resolution. Therefore, information relating to the timing of changes in the vocal tract resonance is more reliably obtained than with narrowband spectrograms. The bandwidths used to generate wideband spectrograms are generally between 200 and 500 Hz.

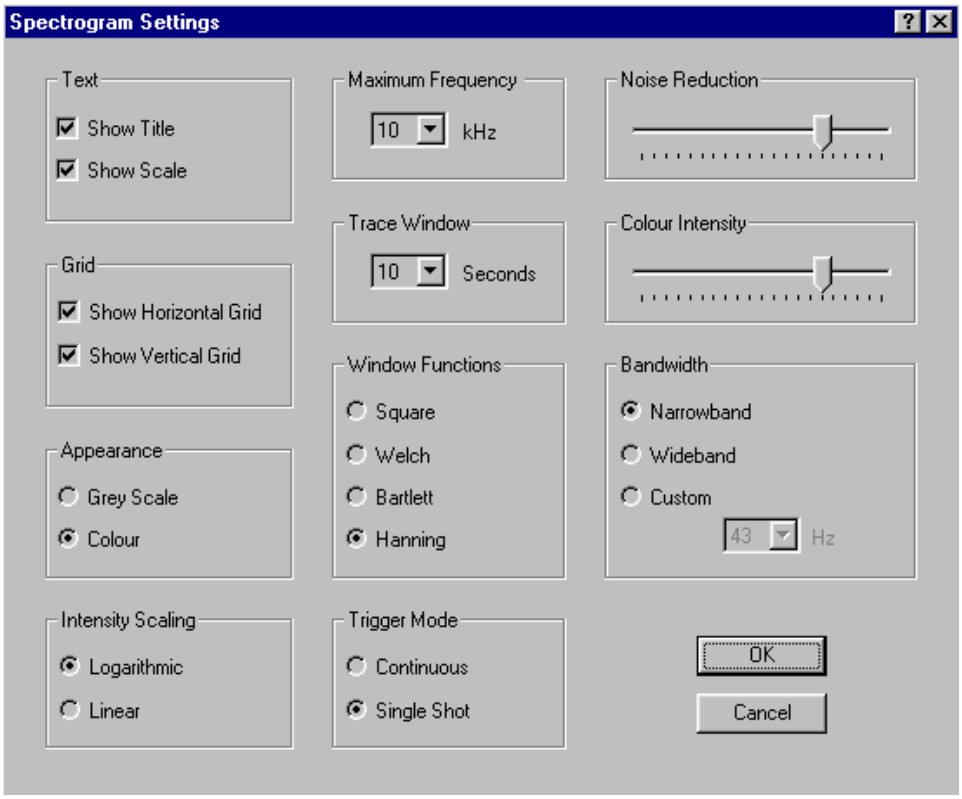


* A wideband spectrogram of the utterance /ɛɪ/, /i/, /ʊ /, /ʃ/.

The real-time spectrogram

The real-time spectrogram option allows the user to view the complex speech patterns as they are spoken, making it extremely useful as a biofeedback tool. The speech signal is captured by the host computer's sound card via a microphone connected either directly or through SNORS+. Once captured the sampled audio data is processed in 100 ms blocks ensuring that the spectrogram display is updated 10 times a second.

The options available to the real-time spectrogram can be accessed via a single dialogue box.



Maximum Frequency

The maximum frequency that can be displayed on the real-time spectrogram is restricted by the sound card's sample rate. The Nyquist sampling theorem states that only sampled data with frequencies up to *sample rate / 2* can accurately be reproduced. The sound card in this application has been programmed to sample at 22050 samples per second and so the maximum displayable frequency is 11025 Hz. For clarity, this frequency has been rounded down to 10 kHz. The user is able to select any frequency range between 1 and 10 kHz in 1 kHz steps. The default frequency range is 10 kHz.

Trace Window

The time base determines how long it takes the spectrogram trace to travel the width of the window. The default window width is 10 seconds but may be adjusted from 1 to 60 seconds in 1-second steps.

Bandwidth

As mentioned above, bandwidth affects the appearance of the spectrogram. Narrower bandwidths are useful for resolving finer frequency information, however, they do yield poor timing information. Wider bandwidths exhibit the reverse characteristics, displaying good timing resolution at the expense of frequency resolution. The following table summarises the available bandwidths and their relationship to the spectrograms timing resolution.

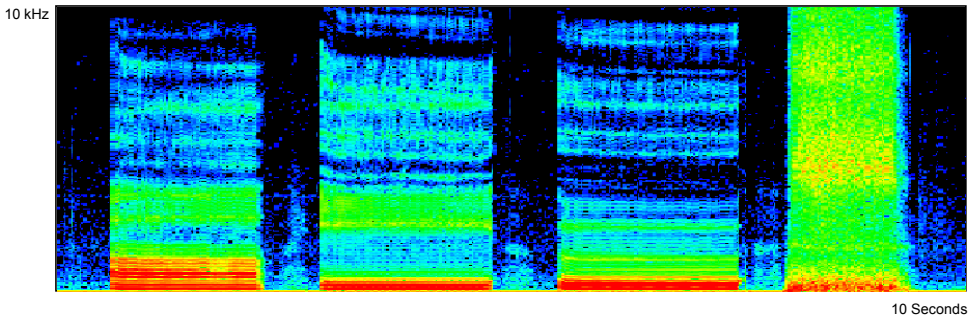
Bandwidth (Hz)	Timing Resolution (ms)	FFT Length
11	90.90	2048
22	45.45	1024
43	23.25	512
86	11.63	256
172	5.81	128
345	2.90	64
689	1.45	32

* Available bandwidths, their respective timing resolution and FFT length

The user may select any of the tabulated bandwidths. Alternatively, two predefined bandwidths have been included: narrowband and wideband, which have bandwidths of 43 Hz and 172 Hz respectively.

Trace Appearance

Spectrograms commonly employ grey scales to represent the varying speech intensities. The darker the image the greater the intensity, with white areas representing silence. However, an alternative to grey scale is the colour spectrum, which represents the maximum intensity as red gradually decreasing through orange, yellow, green and blue. Silence on the coloured spectrogram is represented by black.



* A narrowband spectrogram featuring colour scale intensities.

Colour Intensity

Colour or grey scale levels may be adjusted by the colour intensity slider. This is useful for increasing the intensities of low level acoustic signals that may otherwise be concealed. A gain factor of up to 20 is provided by the colour intensity control.

Noise Reduction

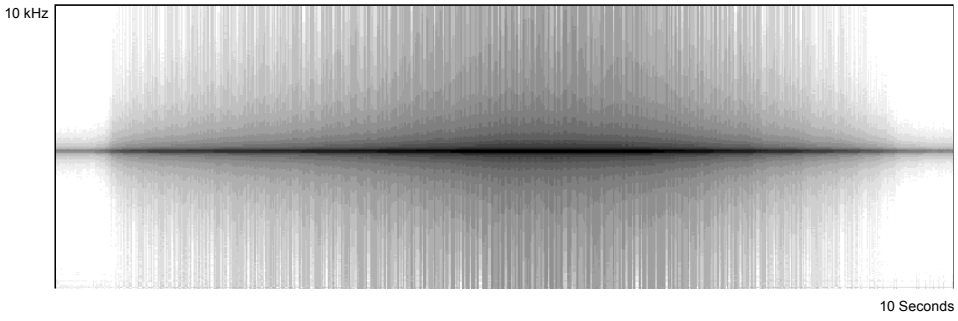
A noise reduction slider has also been included which enables the user to minimise the effects of background noise. Noise on the spectrogram is characterised by a "snowy" background and whilst generally not presenting a problem the user may wish to improve image quality by removing this. Up to 20 dB of attenuation is provided by the noise reduction control.

Data Windowing

As previously mentioned the fast Fourier transform (FFT) separates the acoustic signal into sinusoidal waveforms of different frequency. Once separated each sinusoid is placed in its own respective frequency "bin". The number of frequency bins representing the acoustic signal is determined by the FFT length. The relationship between frequency bins and FFT length is given by:

$$frequency\ bins = \frac{sample\ rate}{FFT\ length}$$

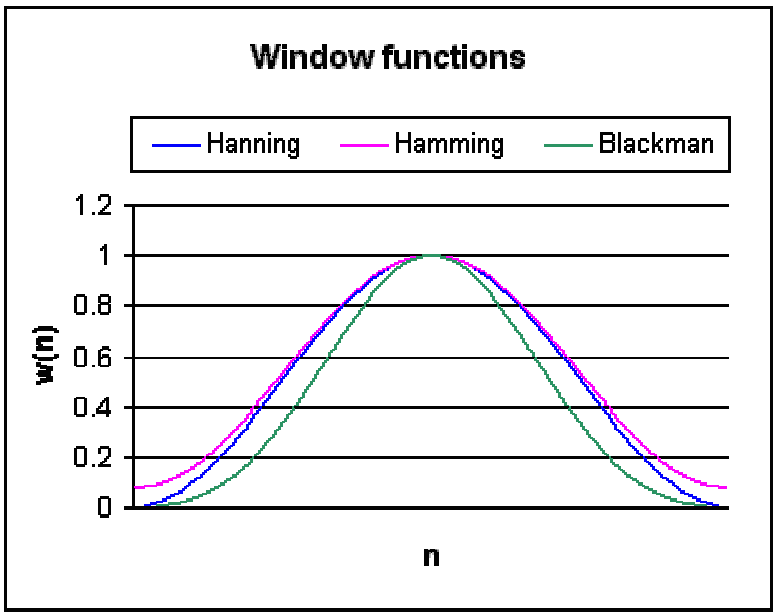
In general, spectral power in one bin may contain leakage from frequency components in neighbouring bins; this is often referred to as spectral leakage. Spectral leakage may be seen as blurring on the spectrogram image.



* A Spectrogram of a pure tone, with varying intensity, exhibiting spectral leakage.

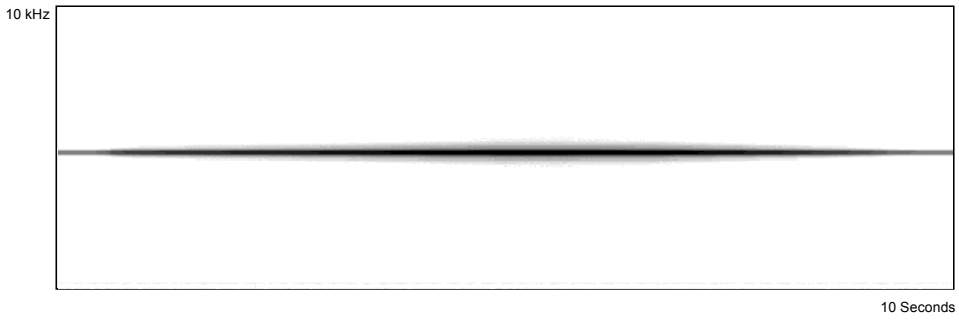
Spectral leakage occurs when a frequency component of the acoustic signal does not slot exactly into one of the frequency bins. This effect can be significantly reduced by applying a window function to the sampled data. Using this technique, data samples

are multiplied by a function that tapers towards zero at either end. This ensures that the signal fades in and out rather than starting and stopping abruptly. The effect is to reduce discontinuity at data boundaries and hence the amount of leakage. However, window functions do broaden the spectral peaks of the acoustic signal, making it difficult to distinguish certain frequency components. A number of window functions have been devised. Some are effective in reducing spectral leakage, at the expense of spectral detail, while others try to achieve a compromise. The Figure below illustrates a selection of data windowing functions.



* A selection of data windowing functions.

The effect of applying a Hanning window function to the waveform depicted above is shown below. It is apparent that the blurring around the centre frequency has been significantly reduced.



* The effect of applying the Hanning window function to a pure tone of varying intensity.

Intensity Scaling

The acoustic signal intensity may be represented on a logarithmic or linear scale. By default, the intensity scale is logarithmic, which generally boosts the lower intensity high frequency components of the acoustic signal. This makes it useful for examining harmonics of the fundamental frequency or the higher frequency components produced by fricatives such as /s/. Unfortunately, the logarithmic scale also increases background noise intensity.

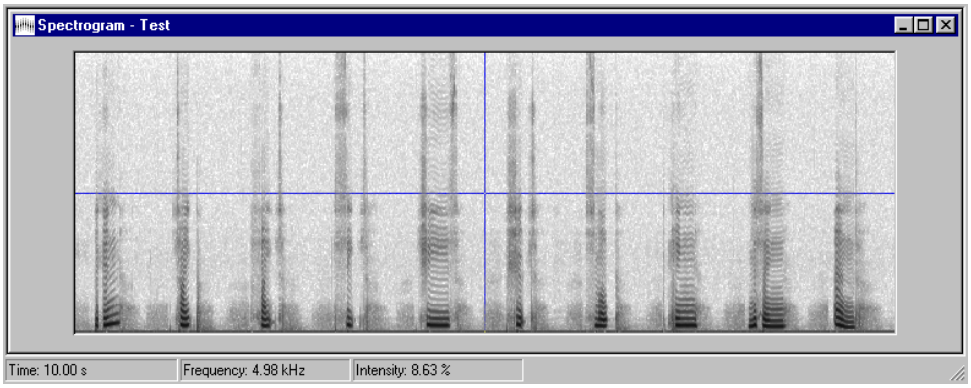
Linear intensity scaling produces a much “cleaner” spectrogram but low level acoustic information is often lost. Linear scaling is useful when examining the high intensity signals usually associated with fundamental frequency.

Trigger Mode

In continuous mode the spectrogram trace repeatedly scans across the display which is refreshed at the end of each scan. However, in single shot mode the trace is suspended once the end of the spectrogram window is reached. This is useful for obtaining complete real-time spectrogram images. To reactivate the trace the user may either toggle the pause key or press the ‘A’ (Activate) key.

The Crosshair Cursor

The crosshair cursor allows quick identification of spectrogram related parameters such as frequency, timing and intensity. Once activated the user simply places the cursor over the area of interest and examines the parameters displayed in the status bar. The crosshair cursor may be activated via the toolbar or menu option.



* A spectrogram with the crosshair cursor enabled.

Saving the Real-time Spectrogram

The real-time spectrogram image can be saved at any point during data capture. The user simply suspends the trace by either toggling the pause key or pressing the ‘S’ (Suspend) key and then initiating the “Save As” dialogue.

The test spectrogram

When a test is performed with the “Record Audio” option enabled, a spectrogram of the recorded speech may be obtained. This is displayed automatically if the “Show Spectrogram” option is ticked prior to performing the test. Alternatively, it may be invoked after the test via the “Show Spectrogram” menu option. With the exception of the trace window and trigger mode options, all of the features described in the real-time section also apply to the test spectrogram.

The Linear Predictive Coder

The Linear predictive Coder (LPC) utilises a model-based approach to display a spectrum that shows the resonances (formants) without the complication of the fundamental frequency and its harmonics. While it provides a useful alternative to the FFT, it does have the limitation that it assumes a series of resonators with no branches (i.e. oral or nasal port, but not both). Hence erroneous results can be achieved when using an LPC in cases of velopharyngeal incompetence (VPI).

Chapter
10

The Toolbar

Step-by-step guide to using SNORS+ from the toolbar

The toolbar provides a quick and easy means of using SNORS+. All of the commonly used functions are available on the toolbar, providing shortcuts to most operations.

Toolbar buttons

The toolbar is grouped into five sections: a “General” section, on the left, “Therapy”, “Shared” and “Test” sections, in the middle, and an “Audio/Video” section, on the right.

| General | Therapy | Shared | Test | Audio/Video |

General

Open

Brings up the Windows File “Open” dialog box. The user can then select a previously recorded test or therapy session to open.

Save

Brings up the Windows “Save As” dialog box. The user can then type in a file name and click “OK”, to save the test or therapy results. If the test has previously been saved, the saved file is updated (overwritten) with the current data.

Print

Opens the “Printer” dialog box to allow the active window to be printed.

Close All

Closes all open windows.

Therapy

New Scope

Opens a real-time scope window

New Wave

Opens a real-time high-resolution Wave window.

New FFT/LPC

Opens a real-time FFT/LPC (spectrum) window.

New Spectrogram

Opens a real-time Spectrogram window.

New Bar

Opens a real-time bar window.

New EPG

Opens a real-time EPG window.

Open EPG Model

Brings up the Windows File Open dialogue box to show all model EPG files. The user can then select a target EPG to open.

Video

Opens a real-time video window.

Shared (applicable to both Therapy and Test)

Laryngograph®

Converts a SNORS Bar into a Laryngograph® Bar. Adds Laryngograph® Voicing Intensity and Fundamental Frequency channels to an open Scope window.

Auto Arrange

Automatically arranges all open windows.

Test (Assessment and measurement of outcome)

New Test

Opens the SNORS+ “Test Settings” dialogue box, to allow a new test to be performed.

Repeat test

Opens the SNORS+ "Test Settings" dialogue box, to allow a repeat test to be performed, using the same patient data as the currently open test.

Show Patient Info.

Displays the "Patient Information" box in the current test window. If the "Patient information" box is currently displayed, pressing the "Show Patient Info." button removes it.

Show Analysis

Displays the "Analysis" box in the current test window. If the analysis box is currently displayed, pressing the "Show Analysis" button removes it.

Show Track Cursor

Activates the "Track Cursor", to allow point measurements to be made and individual EPG and/or bar snapshots to be viewed.

Show Block Cursor

If a Test window is active, this activates the "Block Cursor", to allow average measurements to be made and mean EPG and/or bar trends to be viewed.

If an FFT/LPC window is active, a crosshair "Measurement Cursor" is activated. This allows spot measurements of intensity/frequency to be made from the FFT/LPC window.

If a Spectrogram window is active, a crosshair "Measurement Cursor" is activated. This allows spot measurements of intensity/frequency/time to be made from the Spectrogram window.

Zoom

Activates the "Zoom Cursor", allowing the user to zoom into a portion of the display by dragging a box over the required area.

Animation (including Audio/Video Playback)

Skip Backwards

"Skip Backwards" causes the Track or Block cursor (if active) to move from right to left. "Stop" is functional during this process and functions to stop the cursor where it is (i.e. it does not reset the cursor). "Pause" and "Loop Playback" do not function during skip operations.

Play

The "Play" button starts Audio/Video playback, or simple animation if there are no audio or video data recorded. If no cursor is activated, playback commences at the left-hand edge of the active window and ends at the right-hand edge of the window. If

a track cursor is active, playback commences at the cursor and ends at the right-hand edge of the window. If a block cursor is active, playback commences at the left-hand edge of the block and ends at the right-hand edge of the block.

Pause

Pressing the “Pause” button stops playback. The playback cursor (dotted line) remains in place at the point where playback was stopped. Pressing “Pause” a second time restarts playback from where it left off.

Stop

The “Stop” button stops playback and resets the animation cursor.

Skip Forward

“Skip Forward” causes the Track or Block cursor (if active) to move from left to right. “Stop” is functional during this process and functions to stop the cursor where it is (i.e. it does not reset the cursor). “Pause” and “Loop Playback” do not function during skip operations.

Loop Playback

By pressing the “Loop Playback” button, a sequence can be replayed continuously (until “Stop” is pressed), by pressing the “Play” button.

Chapter
11

Shortcut keys

Step-by-step guide to using SNORS+ shortcut keys

There are a number of shortcut keys that, in combination with the toolbar, provide a quick and convenient way of controlling SNORS+.

+ / -

The **+** and **–** keys on the numeric keypad provide a quick way of increasing or decreasing the sensitivity of the display in the active window (Scope, Bar or Wave).

Pause

Pressing the **Pause** key stops all active widows. The header in the title bar changes from "Active" to "Suspended". Pressing the **Pause** key again restarts the displays.

S

Pressing the **S** key suspends (freezes) the "active window".

A

Pressing the **A** key makes the "active window" active (if it was previously suspended).

Print Screen

Pressing the **Print Screen** key copies the entire screen display to the clipboard. This can subsequently be pasted into a word processor or other document. This is useful for writing reports or papers, where a graphic picture is required. It is not recommended that this technique be used for routine printout of clinical test results. The **Print** function, which is intended for this purpose, provides a quick and easy way of obtaining such hardcopies.

U

Pressing the **U** key, when the active window is a Bar selects the upper target marker, allowing it to be moved up or down with the **Page Up** and **Page Down** keys.

L

Pressing the **L** key, when the active window is a Bar selects the lower target marker, allowing it to be moved up or down with the **Page Up** and **Page Down** keys.

Page Up

When a Bar window is active, and target markers are turned on, **Page Up** moves the selected target marker upwards.

Page Down

When a Bar window is active, and target markers are turned on, **Page Down** moves the selected target marker downwards.

← / →

When a track cursor is enabled and a Scope window is active, these keys move the cursor left or right. When a block cursor is active, these keys allow the entire block to be moved left or right.

↑ / ↓

When a block cursor is enabled and a Scope window is active, these keys allow the width of the block to be increased or decreased.

Chapter
12

The Menus

Step-by-step guide to using SNORS+ direct from the menus

Like all Windows 95/98® applications, SNORS+ can be driven entirely from the menu bar. All menus follow the Windows 95/98® standard. The menu items available depend on what operation is currently being performed – i.e. the available options reflect the task being carried out. At start-up, for example, there are relatively few options available to the user, whereas during analysis, there are many menu options available.

The menus explained

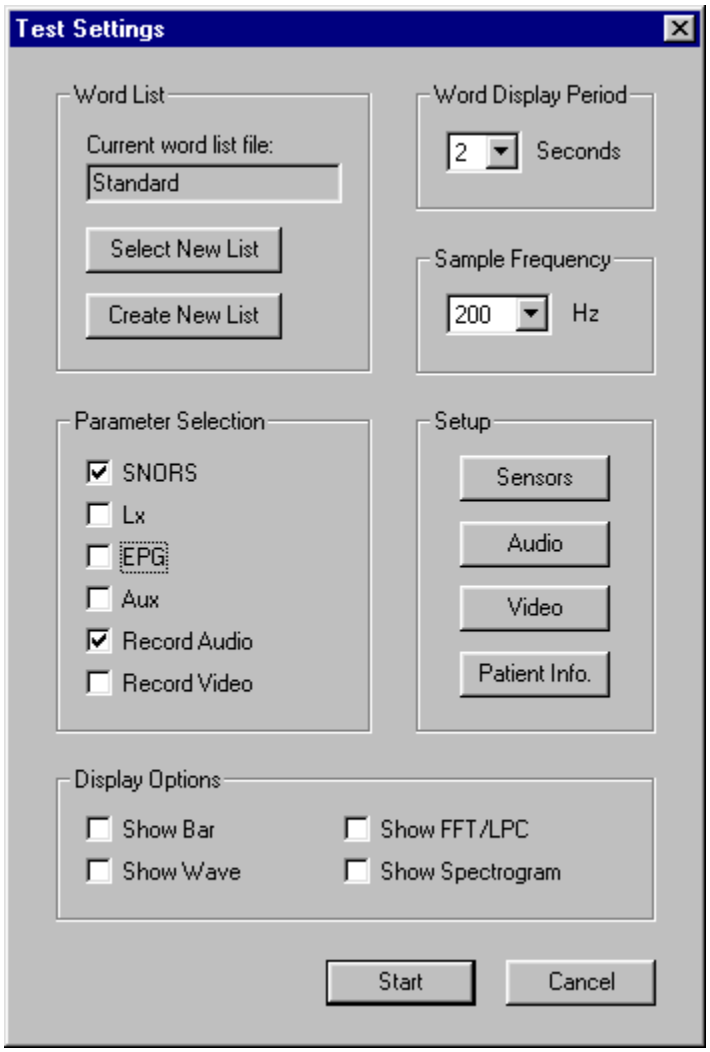
The menu is grouped into seven main headings:

File

New

Test

Starts a new test. The test Settings dialog box first opens, which allows selections to be made if required.

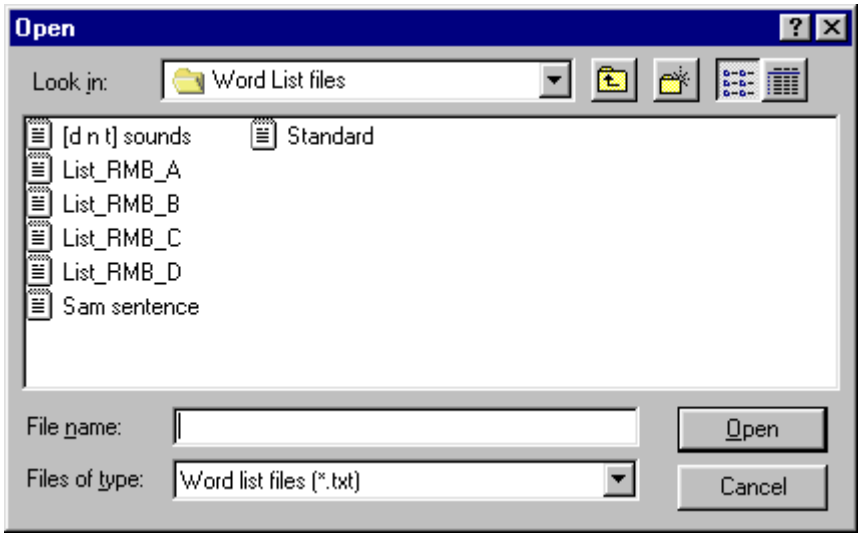


Clicking “Start”, without making any changes, starts the test in default mode.

In most cases, the default settings will suffice. However, a number of changes are possible, and may be made if required.

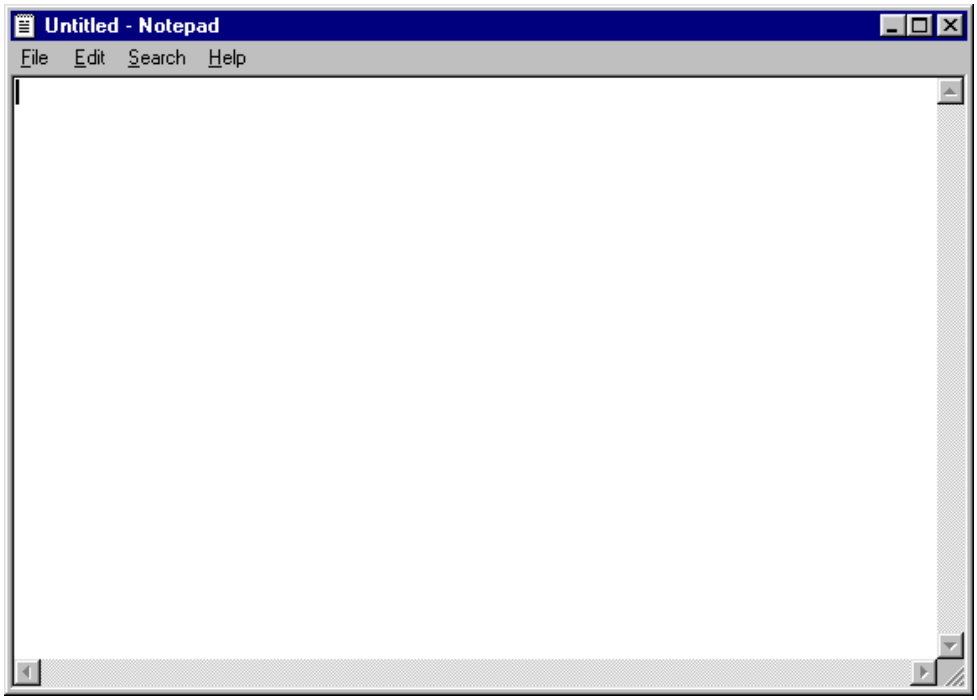
Word List

The “Word List” section of the dialog box indicates the “Current word list file” – i.e. the word list that will be used for the test. By default this is the “Standard” list (standard.txt). An alternative list can be chosen, if required, by clicking the “Select New List” button. This invokes the Windows 95/98® “Open” dialog box, which displays all the available word list files.



A word list is selected by clicking on it and then clicking "Open".

A new word list can be created by clicking the "Create New List" button. This opens the Windows 95/98® "Notepad" text editor.



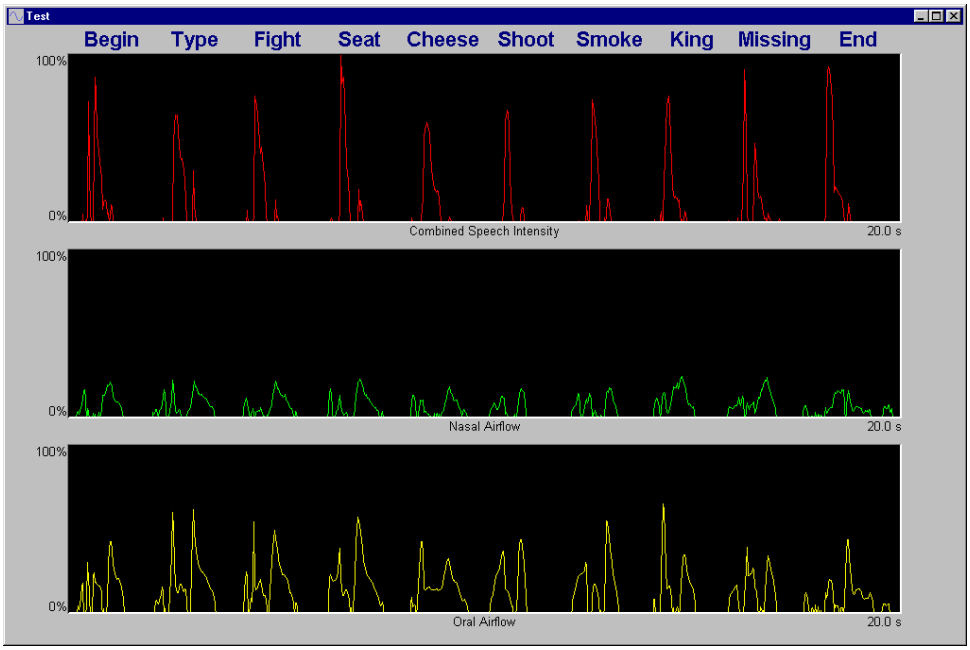
Simply type in the sounds, words or sentences required, starting each on a new line. Do **not** put a return after the final entry. Words will appear on the screen, during a test, exactly as typed.

When the list is complete, it should be saved by clicking "Save" from Notepad's "File" menu. Give the file an appropriate name and be sure to save it in the "Word list files" folder. If the "Save" dialog box defaults to a different folder, move up to the (C:) level and then down to the "SNORS+" folder and down again to the "Word list files" folder.

If a word list is saved without typing anything in, no words will appear on the screen during the test and no words will appear as annotation after the test. An empty word list, such as this, can be used if prompting is not wanted or if the prompt would be too long (such as when recording a passage).

Parameter Selection & Display Options

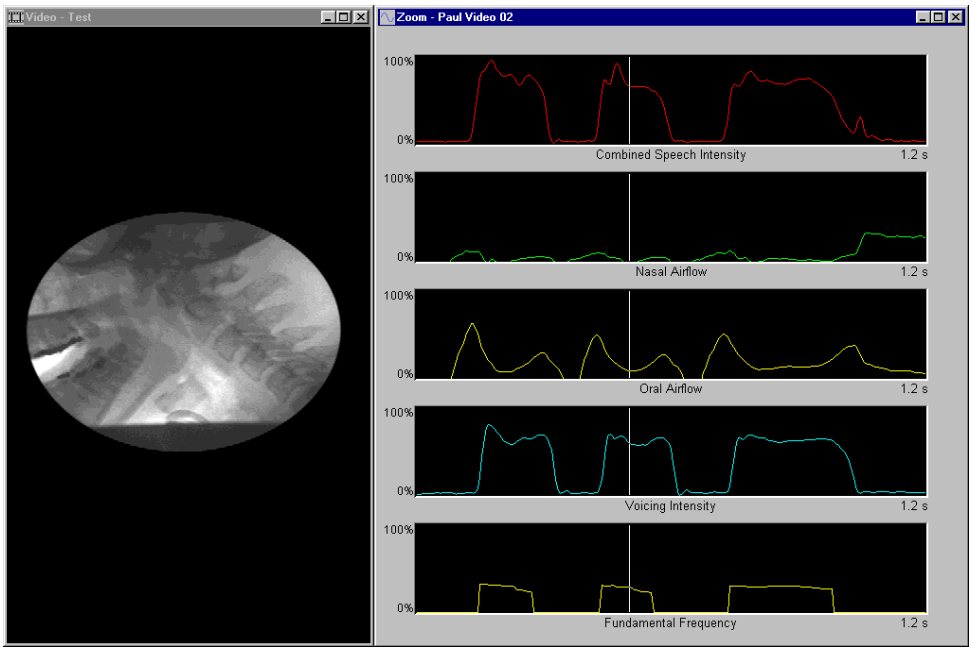
The “Parameter Selection” of the “Test Settings” dialog box must be used if multiparameter testing is required. By default, only “SNORS Scope” and “Record Audio” are selected. This is indicated by the tick in the “SNORS Scope” and “Record Audio” check boxes. Running the test in this default configuration will result in a Scope window, at the end of the test, displaying “Combined Speech intensity”, Nasal Airflow” and “Oral Airflow” waveforms.



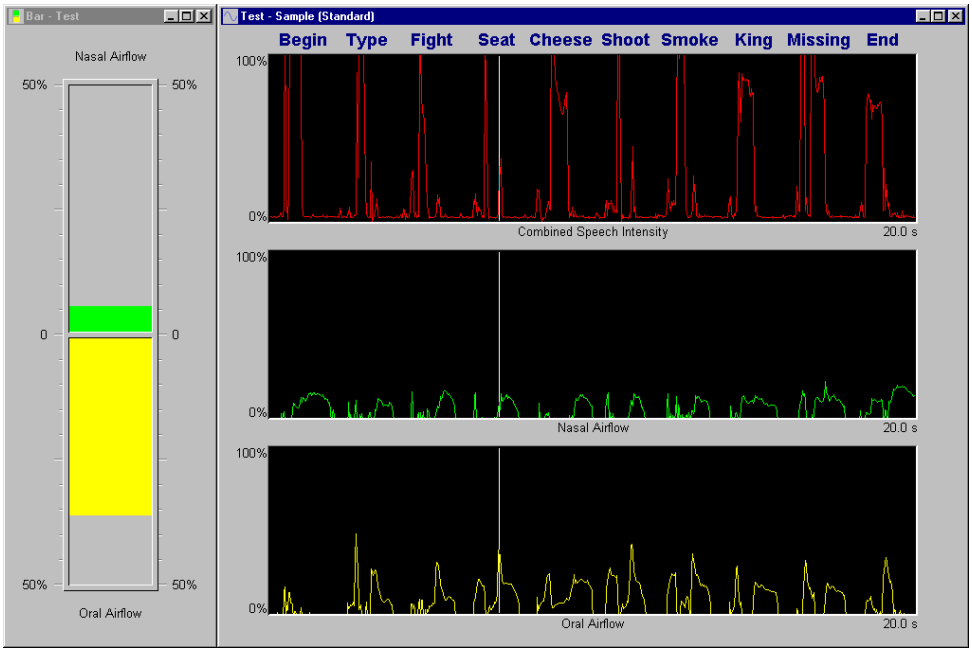
With “Record Audio” checked, speech sounds form the microphones are recorded, in synchronism with the data acquisition, via the PC’s standard sound card. This speech can be played back when the test is reviewed. As the speech is saved as a standard PC format .wav file, it can also be played back, without the SNORS software, using the PC “Sound Recorder” applet. This means that sound recordings can be passed to other therapists, who do not have SNORS, e.g. for independent assessment. Speech is recorded in mono, in SNORS only mode, or to the left stereo channel, if Laryngograph® is used[10].

Checking the “Record Video” box allows video images from a suitable video source to be recorded synchronously with the SNORS data. At the end of the test, a Video window will appear, alongside the Test window.

[10] If Laryngograph® is used, the Lx waveform is saved to the right stereo channel. This allows the user to listen to the Lx signal, if required. However, the main reason for recording the Laryngograph® signal is that the high-resolution Sp & Lx Wave displays are derived from the .wav file.

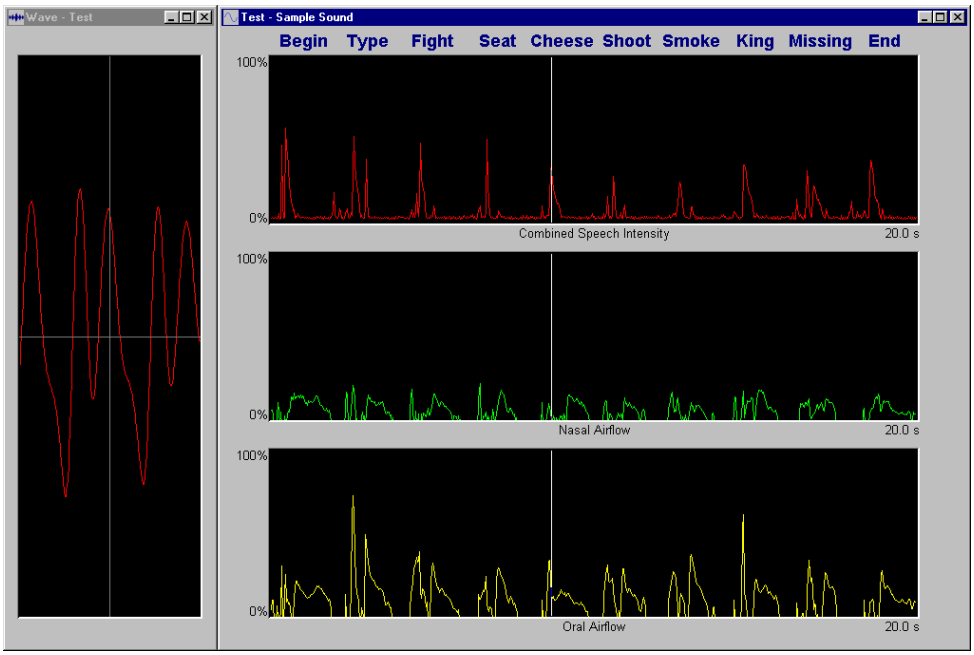


The “Display Options” section of the “Test Settings” dialog box allows the user to select an extra window to display, by default, at the end of the test. [The “Display Options” do **not** affect what is recorded – only the **default** display]. If “Show Bar” is checked, both Test (Scope) and Bar windows will appear at the end of the test (shown below, with Track Cursor enabled).



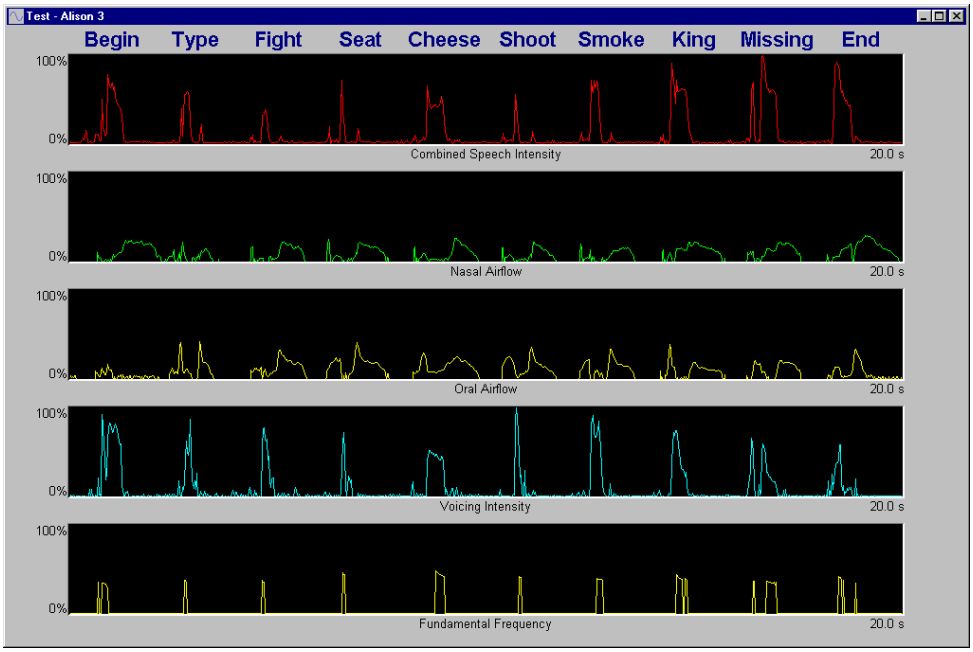
As Bar uses the same SNORS data as Scope, it can be turned on or off at the end of the test, if required (from the “Test” menu).

If “Show Wave” is checked, both Test (Scope) and Wave windows will appear at the end of the test (shown below, with Track Cursor enabled).

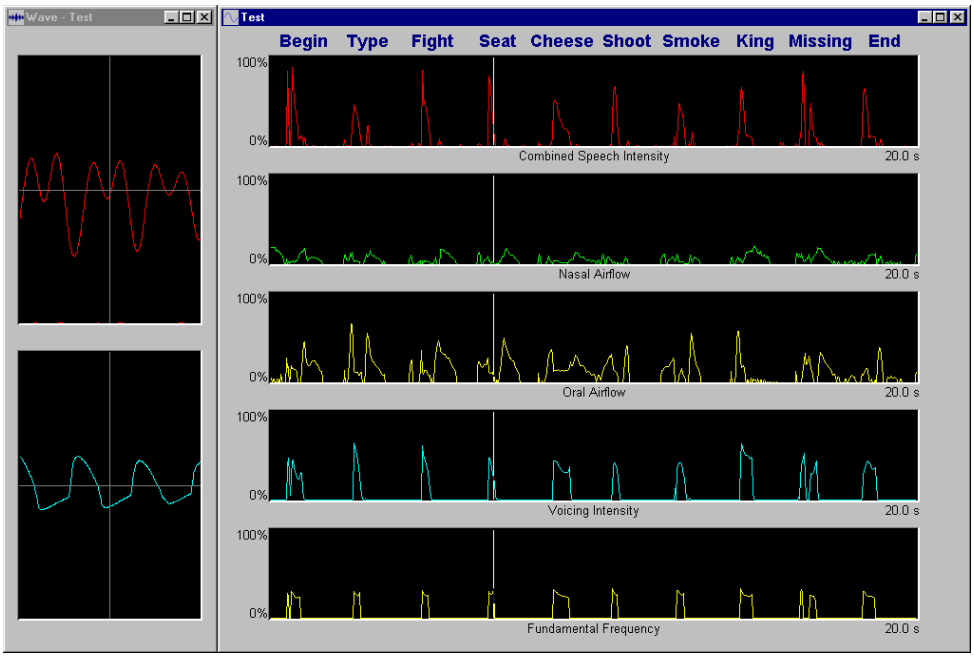


As for Bar, Wave can be turned on or off at the end of the test, if required.

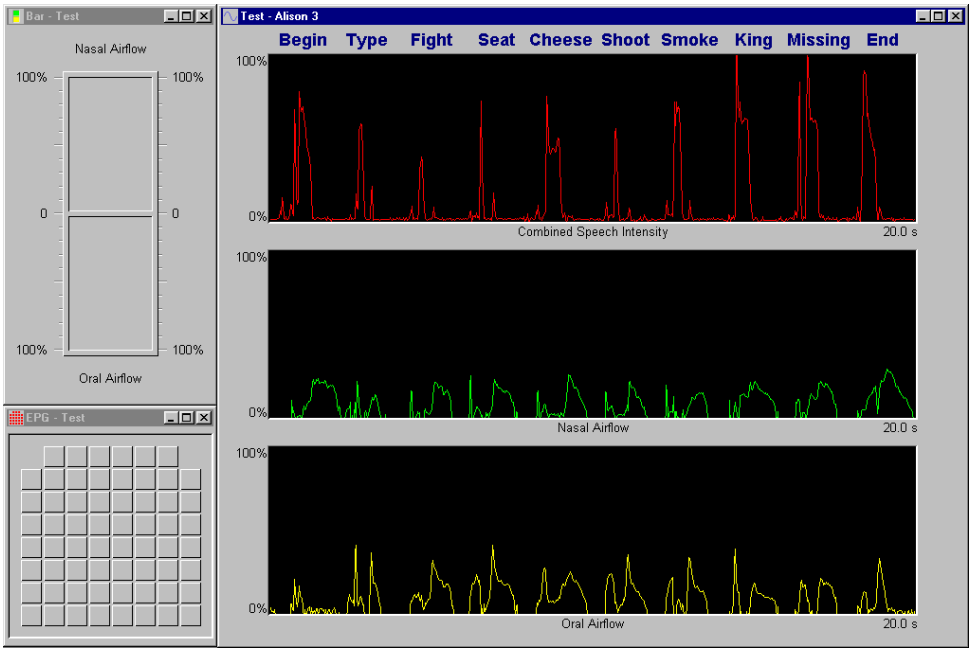
Laryngograph® data will only be recorded if a Laryngograph® unit is connected to the system. When this is done, and the "Laryngograph Lx" box is checked, additional "Voicing intensity" and "Fundamental Frequency" waveforms will appear in the Scope window, at the end of the test.



If "Laryngograph® Lx" and "Show Wave" are **both** checked (and if "Record Audio" is checked and the Laryngograph® unit is switched on), Test and Wave windows will appear at the end of the test. In this case, however, the Wave window will contain two traces – the audio speech signal (Sp) and the Laryngograph® signal (Lx). These traces are colour coded to match their respective Scope traces. The vertical centre-line in the Wave window corresponds to the cursor position in the Test window.



To record Linguagraph electropalatography data, the "Linguagraph EPG" box must be checked and a Linguagraph unit must be connected. In this case, an EPG window will also appear at the end of the test. It is useful to also check "Show Bar" when Linguagraph is being used, as this provides an equivalent snapshot view for SNORS.



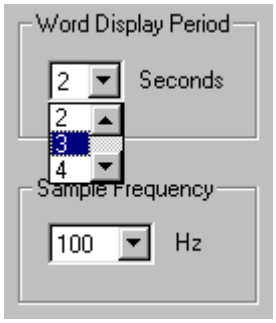
If it is wished to view the detailed speech waveform at the end of the test, "Show Wave" should be checked instead of "Show Bar"[11].

Word Display Period

The time for which each word is displayed on the screen (and hence the time allowed for the patient to utter the word) can be varied by clicking the symbol at the right of

[11] It is possible to check **both** "Show SNORS Bar" **and** "Show Audio Wave". However, this is not recommended as it results in a very cluttered display.

the “Word Display Period” box and selecting the required time (between 1 and 90 seconds).

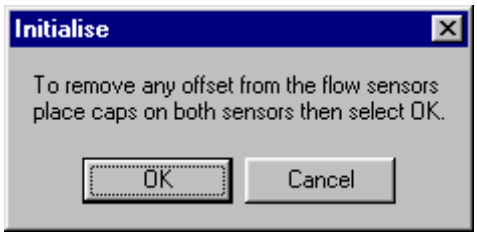


Sample Frequency

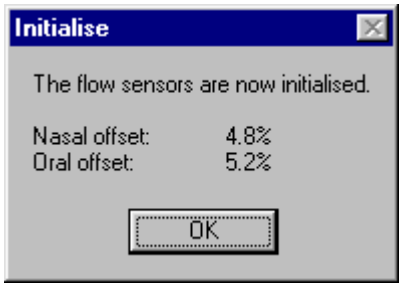
Similarly, the “Sample Frequency” can be changed by clicking on its symbol. Frequencies of 100 Hz or 200 Hz can be used when electropalatography is employed. Without electropalatography, frequencies up to 10 kHz can be used.

Setup

This section provides general set-up functions as well as the facility to enter information about the patient. “Sensors” allows a zero correction to be made to the flow sensors. Pressing this button displays a further dialog box, instructing the user to place the caps on the airflow sensors and then press the “OK” button.



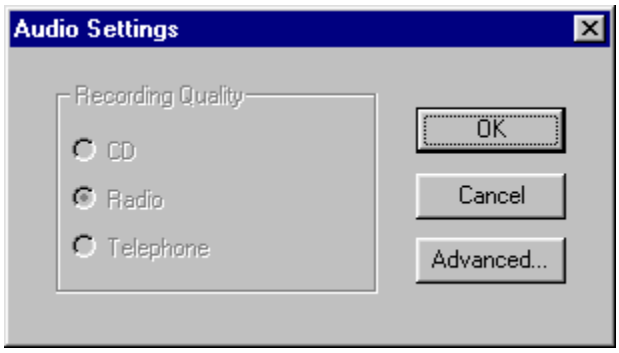
Make sure that the red caps are on the flow sensors, put the mask down on a flat surface, and then answer “OK” by clicking the “OK” button in the dialog box that appears. A new message box appears.



Again, click “OK”. The sensors are now initialised and you can remove the red flow sensor caps, ready to perform the test.

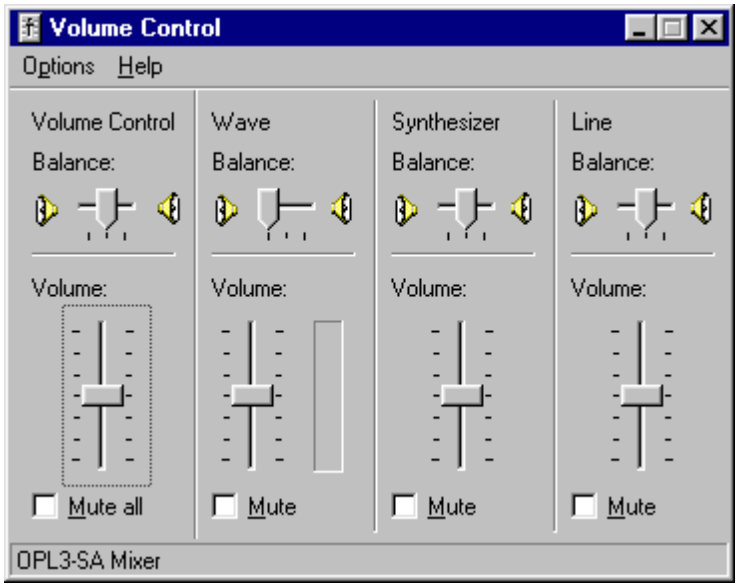
Doing this removes any small offset from the flow sensors. It is recommended that this procedure be carried out once, at the start of each session. (Note: the system can also be initialised from the “Scope” and “Bar” windows).

The “Audio” button allows selection of the audio quality (sound card sampling rate).



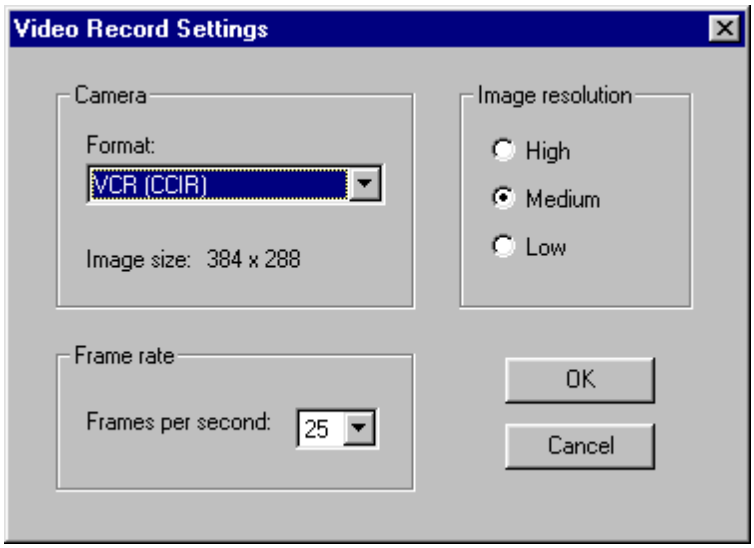
The default quality (Radio) uses a sampling rate of 22 kHz, which should be satisfactory for most purposes. If required, the audio can be increased to CD quality (44 kHz), or reduced to Telephone quality (11 kHz). It should be noted, however, that the higher the quality, the larger the files size! A standard test **without sound** requires just 23 Kbytes of disk space. The same test with "Telephone", "Radio" or "CD" quality sound occupies about 900 Kbytes, 1.8 Mbytes or 3.5 Mbytes, respectively.

Clicking the "Advanced…" button opens the standard Windows "Volume Control" dialog box.



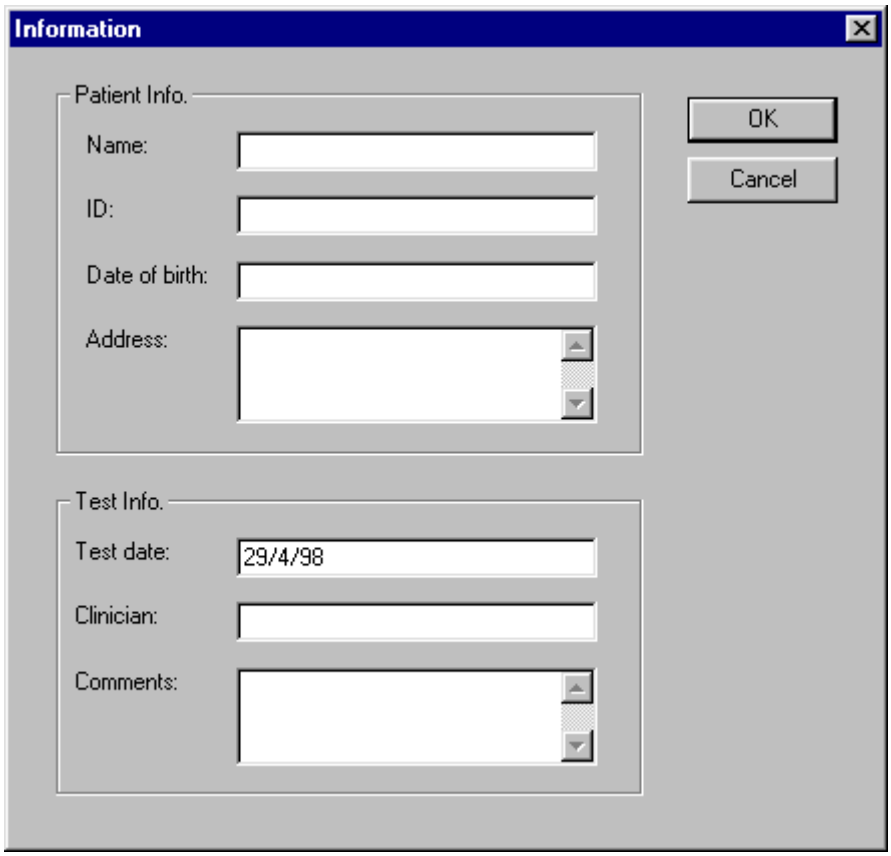
This allows the user to alter the playback volume, using the "Volume Control" and/or "Wave" "Volume" sliders. It is also possible to listen to the Laryngograph® Lx signal, by moving the "Wave" "Balance" slider to the right. This signal, which represents voicing, will be heard a s a buzz.

The "Video" button allows the video parameters to be set.



The “Camera” format section of the Video Record Settings dialog box allows the appropriate video source to be selected. Formats commencing VCR… are designed specifically for recording from videotape. These should not be used with live sources. The “Image size” can be varied by selecting High, Medium or Low resolution from the “Image Resolution” section. The default setting is “Medium”, which corresponds to 384x288 pixels in PAL or CCIR format. Finally, the “Frame rate” can be set, as required. It is usually best to set the frame rate to match that of the video source.

Clicking the “Patient Info.” button allows details of the patient being tested to be entered and stored with the test results. A new dialog box appears, for data entry.



Simply use the mouse to click in a box where it is desired to enter information and type in the details. It is not necessary to enter information in all the boxes – just use those that you require. The “Test date” is automatically entered, but can be changed if required.

When all required selections have been made, they can be implemented by clicking “OK” or rejected by clicking “Cancel”.

Start

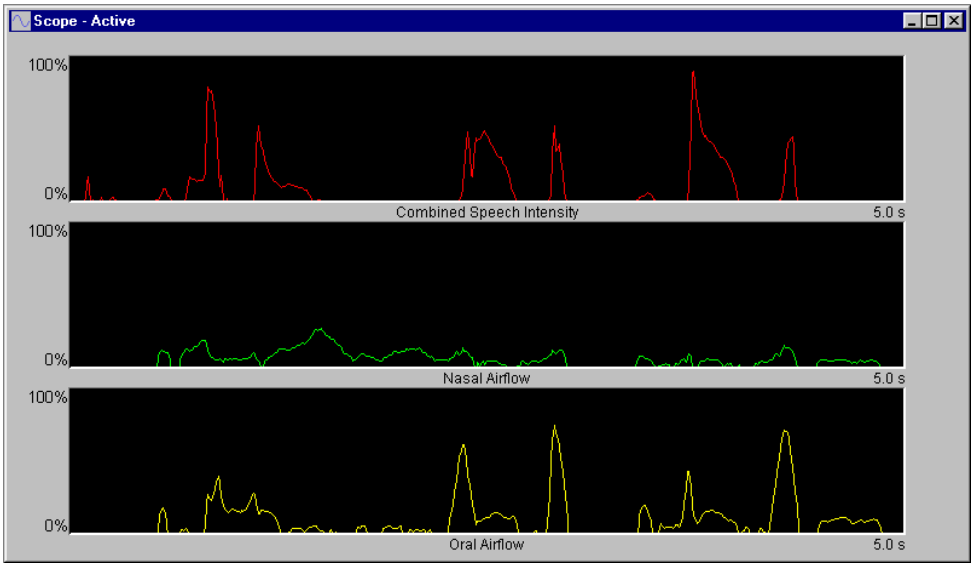
Clicking the “Start” button initiates the test, using the current settings.

Cancel

If it is decided not to proceed with the test, clicking “Cancel” will close the “Test Settings” dialog box without proceeding with the test.

Scope

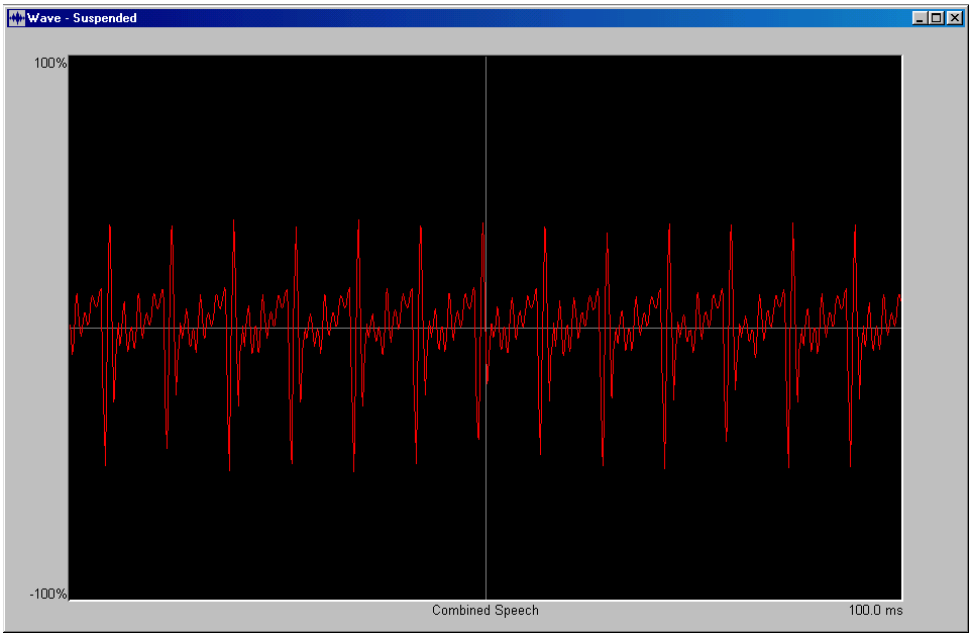
Opens a real-time scope window and starts the scope running.



If a scope is already running, a second one is started in a new window. Provided the speeds are the same, both scopes will be synchronised. Any number of scopes can be run at once.

Wave

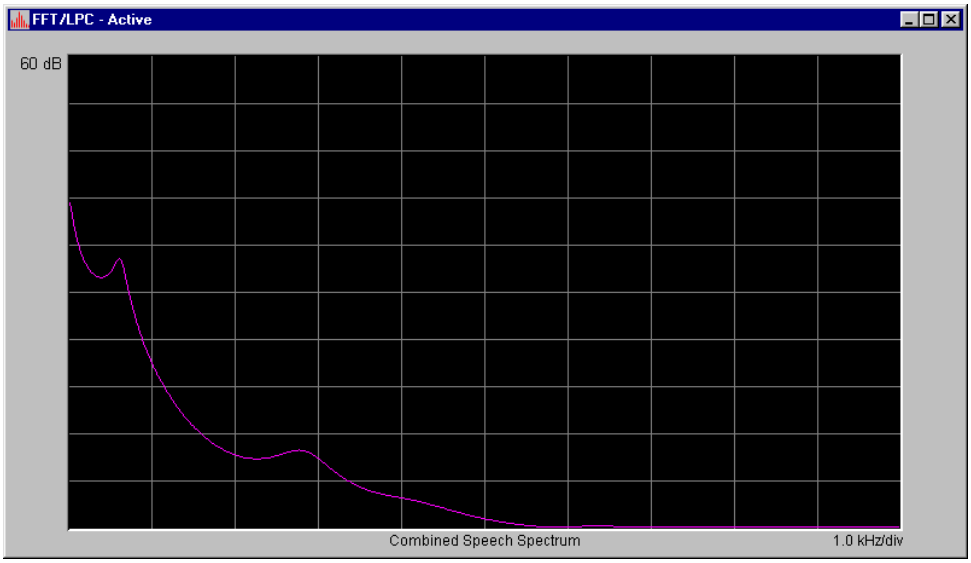
Opens a real-time wave window and starts the wave running.



If a wave is already running, a second one is started in a new window. Provided the speeds are the same, both waves will be synchronised. Any number of waves can be run at once.

FFT/LPC

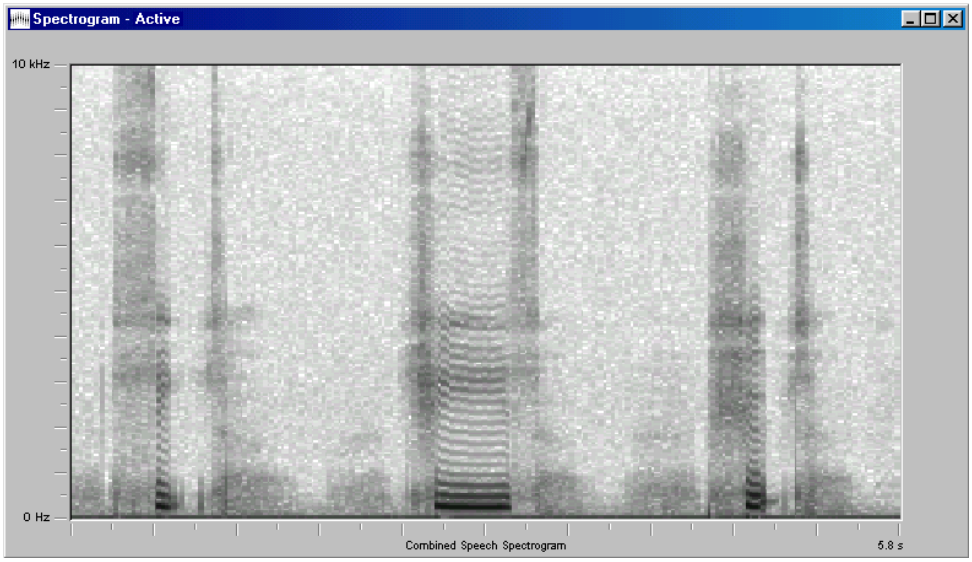
Opens a real-time FFT/LPC (spectrum) window and starts a default LPC running.



If an FFT/LPC is already running, a second one is started in a new window. Provided the speeds are the same, both FFT/LPC's will be synchronised. Any number of FFT/LPC's can be run at once.

Spectrogram

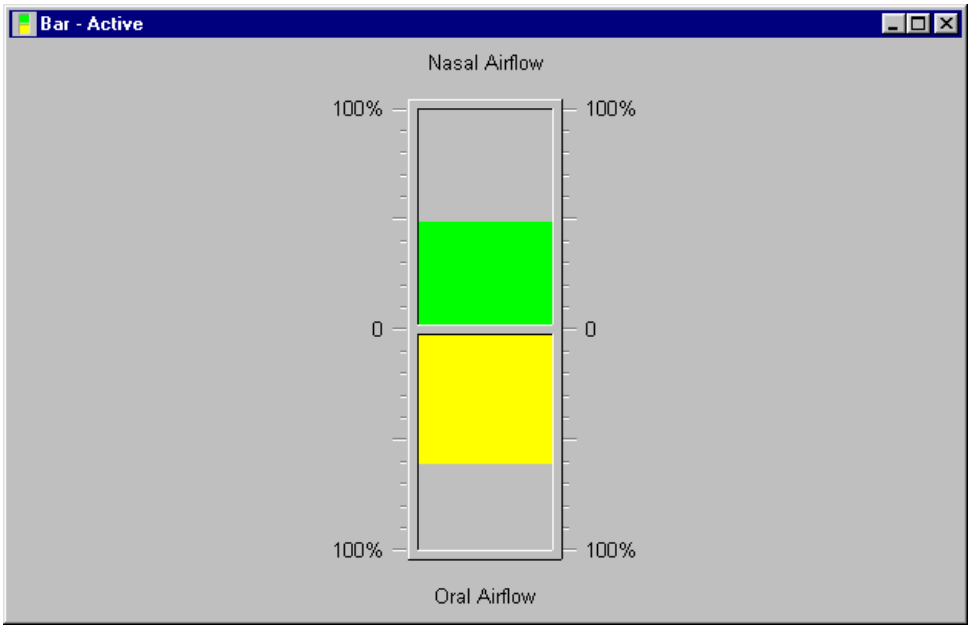
Opens a real-time spectrogram window and starts the spectrogram running.



If a spectrogram is already running, a second one is started in a new window. Provided the speeds are the same, both spectrograms will be synchronised. Any number of spectrograms can be run at once.

Bar

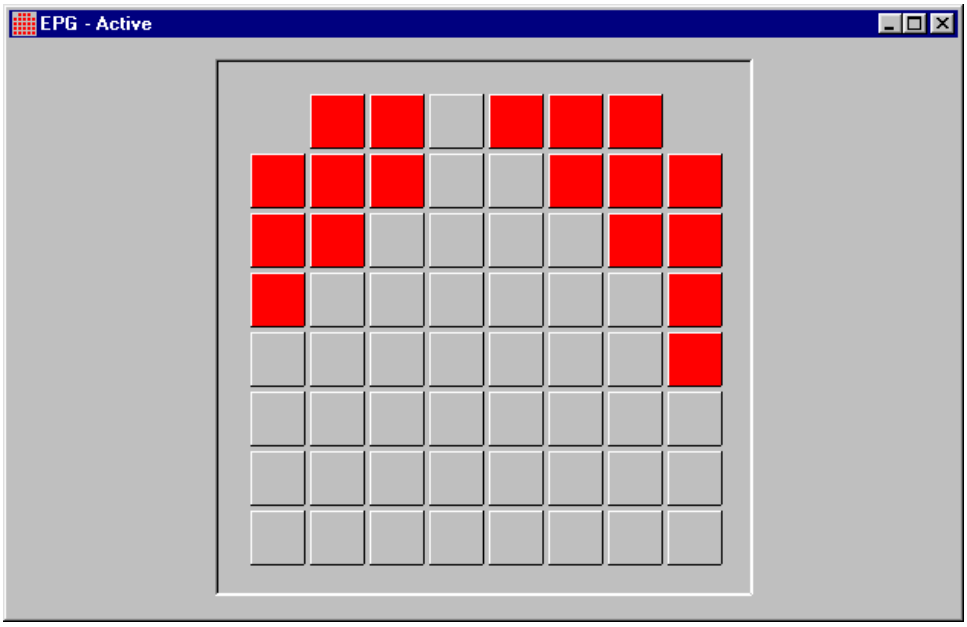
Opens a real-time bar window and starts the bar running.



Several bars can be run at once, if required.

EPG

Opens a real-time Linguagraph (EPG) window and starts the EPG running.



Any number of EPG windows can be run at once.

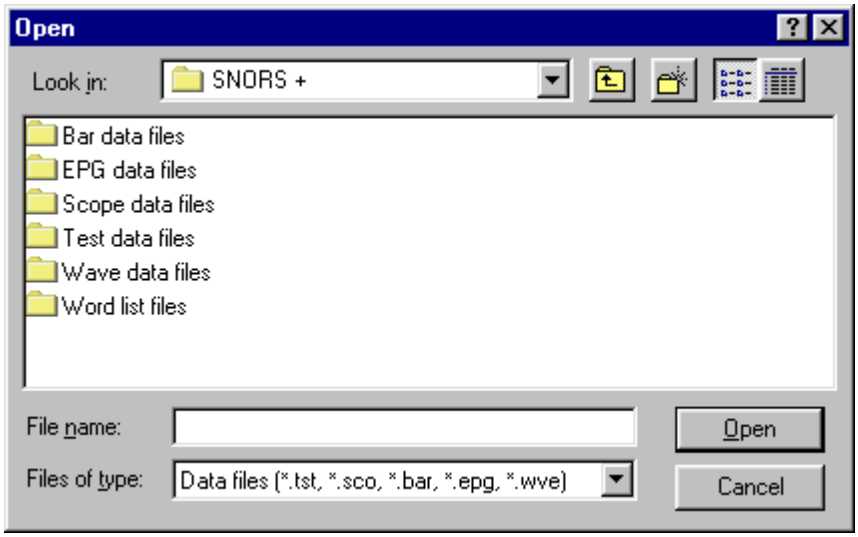
Video

Opens a real-time Video window and starts the Video running.

Only one Video window can be running, but any number of other real-time windows can be run at the same time.

Open...

Invokes the Windows 95/98® “File open” dialog box to allow any previously save file to be opened.



The dialog box shows a list of folders for various types of data files. Test data are stored in the "Test Files" folder. A previously saved test can be opened by double clicking on the "Test Files" folder and then clicking on the test file name and then clicking "Open". Scope, bar or EPG files can be opened by double clicking on the appropriate folder and then and selecting the file to open.

Save

Saves the active window. If the window was previously saved, it will be re-written and any changes which have been made will be incorporated. If the active window is a Test, the complete test data will be saved, including any EPG data. If the active window is a Zoom view of part of a test, the option of saving either the complete test or just the active window will be given (providing the main Test window is still open and has not already been saved).

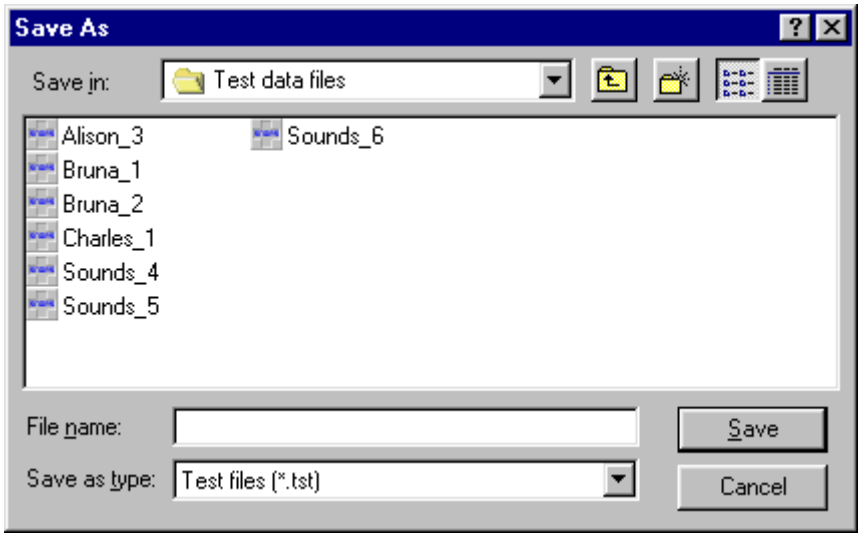
If the active window is a bar or EPG, only the visible snapshot of the window will be saved.

If the file has not been saved before, the Save As dialog box will open (see next section) and a file name must be typed in.

Save As...

Allows a test, or other active window, to be saved with a new name. Any files previously saved will be unchanged.

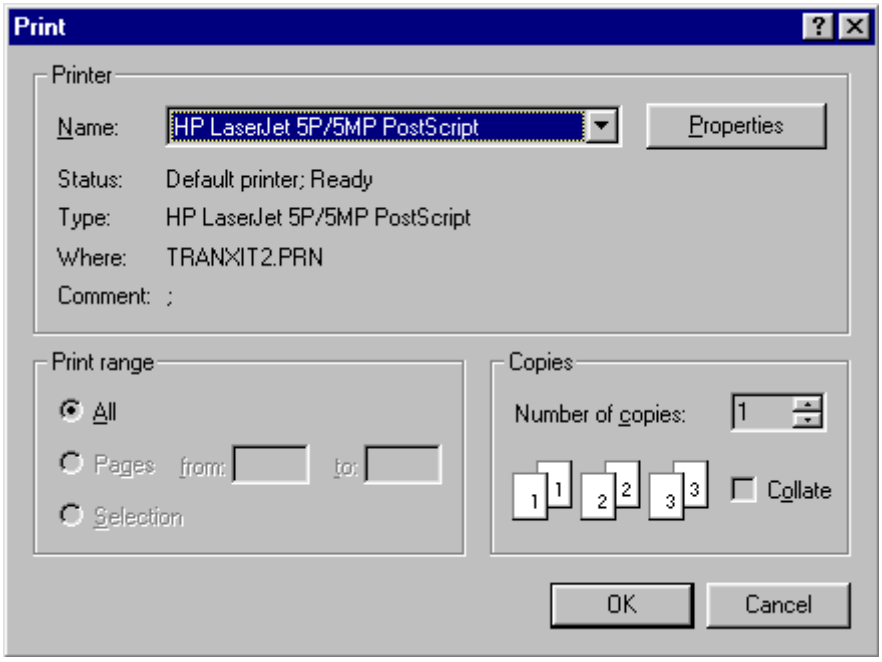
When this option is selected, the Save As dialog box appears.



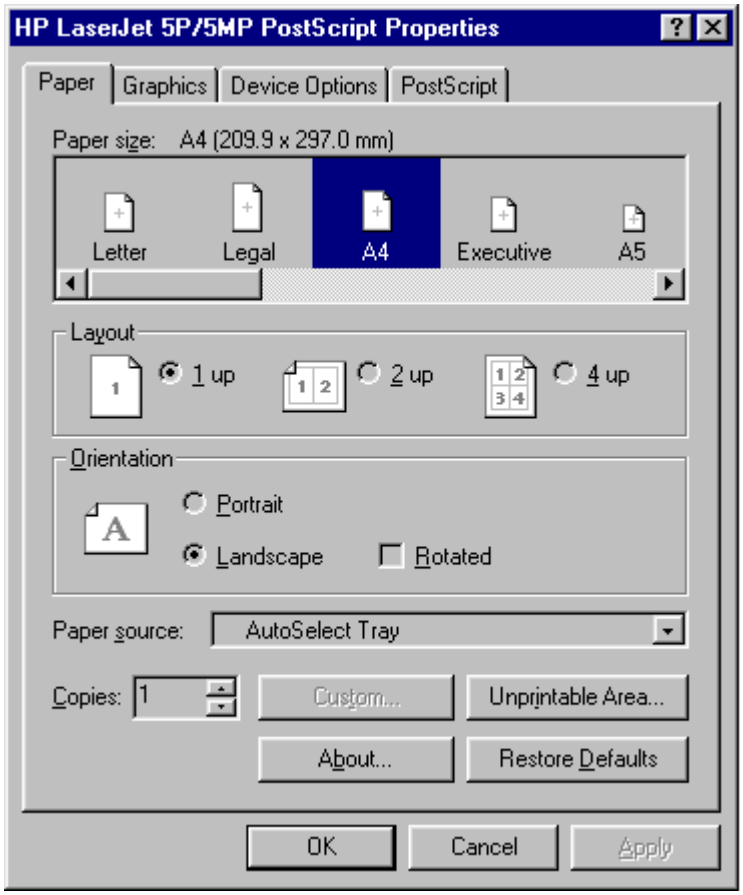
Simply enter the name that you wish to use for the file and click "Save"

Print...

Opens the Windows 95/98® "Print" dialog box, to allow the active window to be printed.



Simply click on "OK" to print the active window. By clicking on "Properties", options such as paper size and orientation (portrait or landscape) can be chosen.

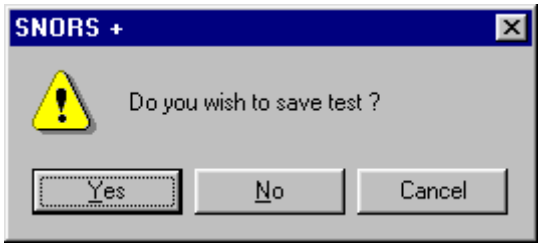


If you have more than one printer available, a different printer can be selected by clicking on the ▼ symbol, next to the "Name" box in the "Print" dialog box.

[Please note that the "Print" and "Printer Properties" dialogue boxes are part of Windows 95/98®. They will reflect the printer(s) that you have installed on your system and may be different to the examples shown above.]

Exit

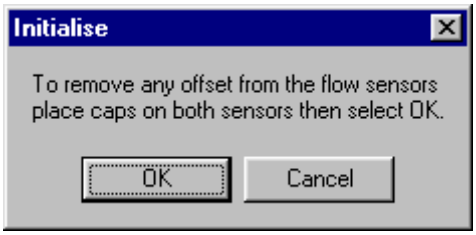
Closes the SNORS+ program. You will be warned if a test has been completed, but not saved, and invited to save the test.



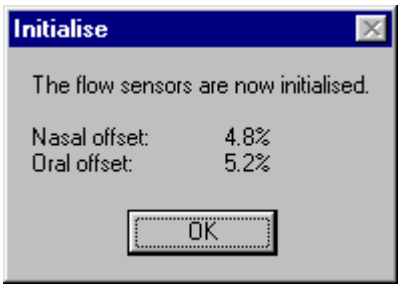
Options

Initialise

When a real-time Bar or Scope is open, it is possible to initialise the flow sensors, to remove any small offset, which may be present. On selection of this option, a message box appears.



Make sure that the red caps are on the flow sensors, put the mask down on a flat surface, and then answer "OK" by clicking the "OK" button in the message box. A new message box appears.



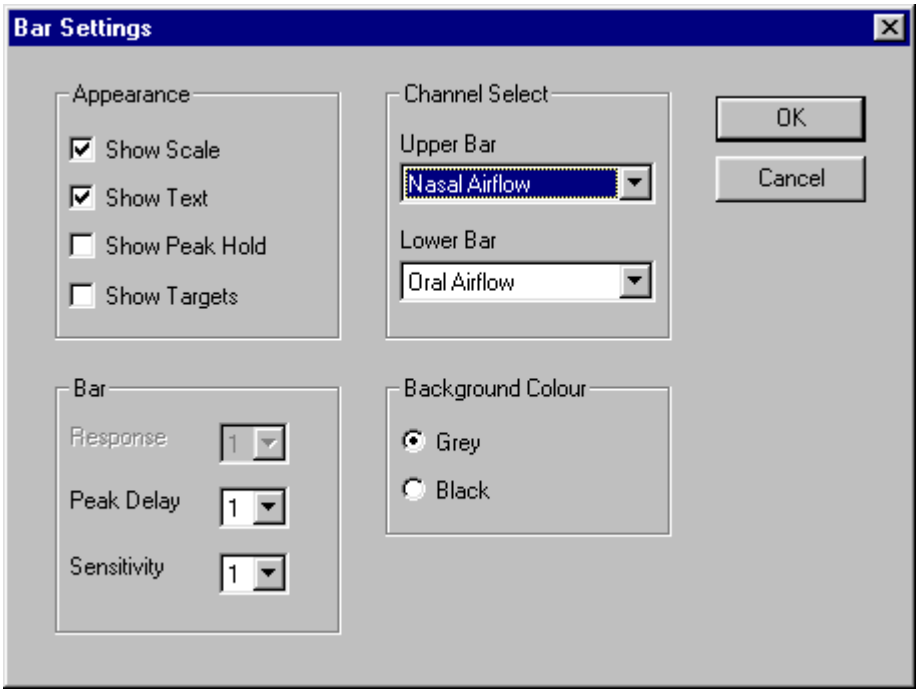
Again, click "OK". The sensors are now initialised, and you can remove the red flow sensor caps.

Settings...

This option enables the characteristics of the active window to be altered. There are five possible types of active window – Bar, Scope, EPG, Wave and Video. Each type has its own "Settings" dialog box.

Bar

The "Bar Settings" dialog box allows the appearance, dynamics, channels and background colour of the bar to be altered.



The “Appearance” section allows bar features to be turned on and off. These are: Scale (e.g.100%), Text (e.g. Nasal Airflow), Peak Hold (indicators which stay at the peak value reached by the bar, for a short time) and Targets (adjustable markers which are used to indicate levels to be reached or kept below).

The Bar section allows the time for which the Peak Hold indicator persists and the sensitivity (gain) to be changed. In real-time mode, the Response speed of the bar can also be varied. This allows the movement to be slowed down, to make it easier to see what is happening.

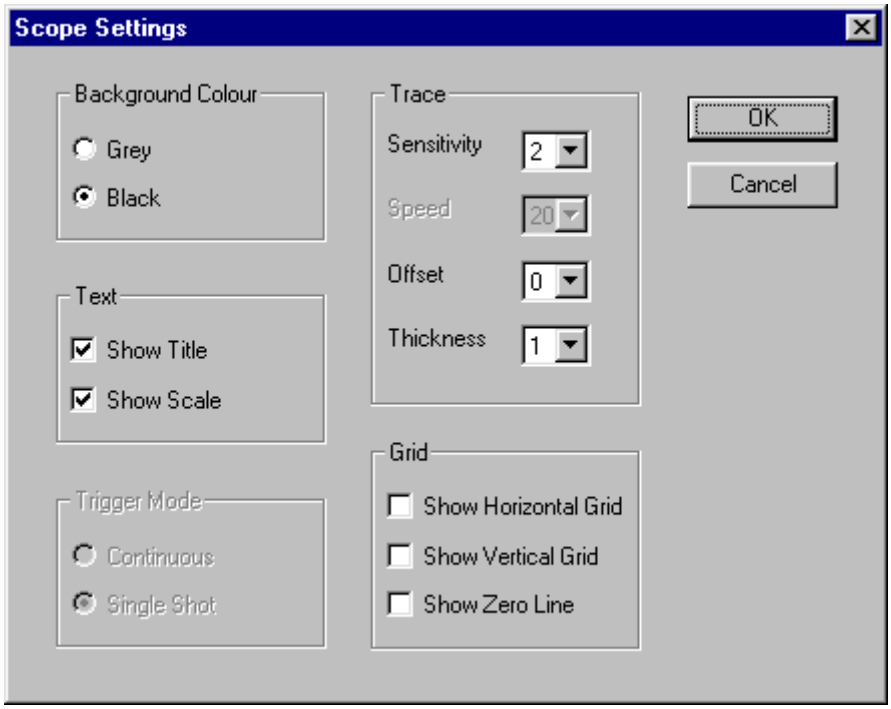
“Channel Select” allows the user to choose which parameters are indicated by the upper and lower bars. Parameters are selected by clicking on the symbol next to the Upper or Lower Bar box and making the required selection from the list that appears.

A “Background Colour” of either grey or black can be selected by clicking the appropriate selector button.

When all required selections have been made, they can be implemented by clicking “OK” or rejected by clicking “Cancel”.

Scope

The “Scope Settings” dialog box allows the appearance, dynamics and background colour of the bar to be altered.



A “Background Colour” of either grey or black can be selected by clicking the appropriate selector button.

“Text” for the title (e.g. “Combined Speech intensity”) and the Scale (e.g. 50%) can be turned on or off independently.

In real-time mode, the Trigger Mode can be changed between “Continuous”, where the trace automatically restarts when it reaches the end of the display, and “Single

Shot", where the trace starts when a key is pressed and stops when it reaches the end of the display. In this mode, the trace can be restarted, after it has stopped, by pressing any key.

Trace Sensitivity (gain) and Offset (which determines how much, if any, negative value is shown) can be adjusted, along with the thickness of the trace line, by clicking on the appropriate symbol and making a selection.

Note about negative airflow

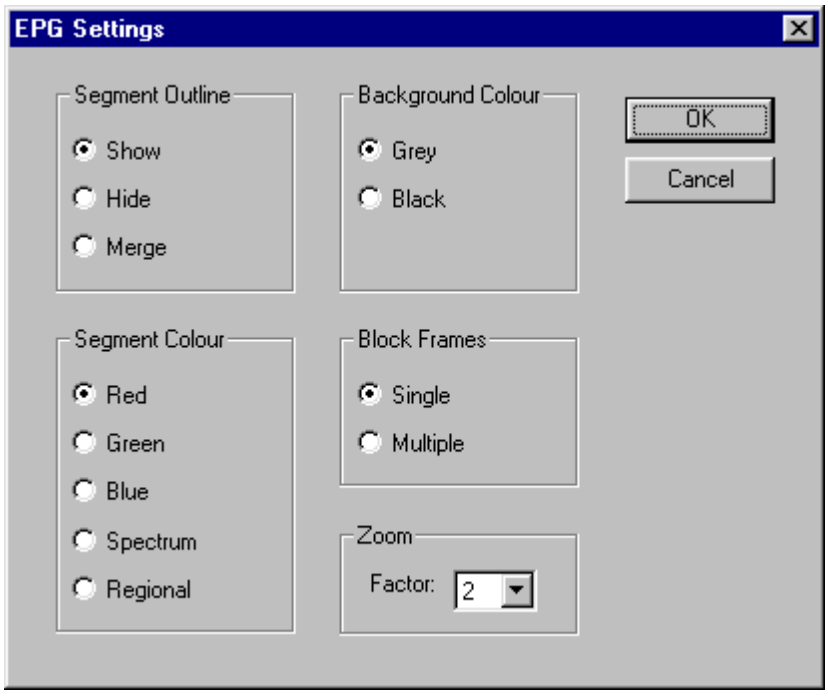
SNORS+ is set up such that only positive airflows are normally shown (offset = 0). This is because negative airflows (inhalation) are normally associated with breathing rather than speech. However, there is sometimes a small amount of negative airflow associated with certain types of speech (e.g. some forms of cleft palate speech). SNORS+ can detect negative flows of up to about 25% of its normal positive range. If it is wished to view negative airflow, an offset must be applied to the traces. An offset of 2 provides a display that matches the range of the flow sensors; i.e. four times as much positive flow is shown as negative flow. If a display with the zero line at the centre is preferred, an offset of 5 can be used.

Finally Horizontal or Vertical Grid lines can be switched on or off, or a single Zero Line can be selected, by clicking in the appropriate selector box(es).

When all required selections have been made, they can be implemented by clicking "OK" or rejected by clicking "Cancel".

EPG

The EPG Settings dialog box allows the appearance of the display to be changed.



By clicking on the appropriate selector buttons, segment and background colour can be changed. Segments can be single colour, multicolour (Spectrum) – where colour represents strength of contact over a selected period of time – or colour coded by

palatal region. It is also possible to show or hide individual segment outlines, or even merge segments together.

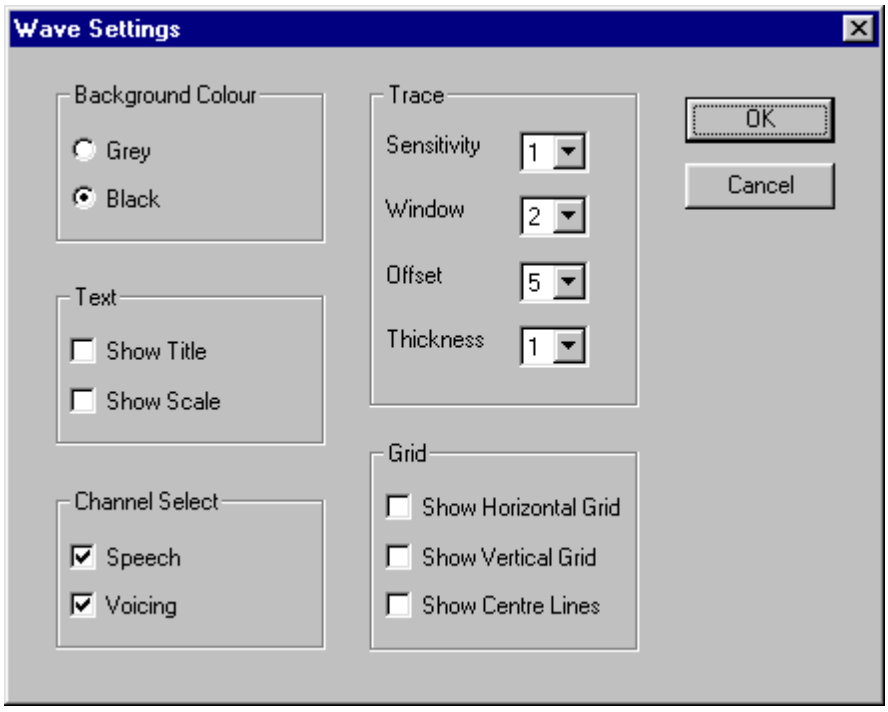
The default "grey scale" EPG image, which appears when a block cursor is in use, can be changed to a sequence of multiple images if required. When using multiple images, it is sometimes useful to zoom in on a part of the sequence. This facility is also provided.

When all required selections have been made, they can be implemented by clicking "OK" or rejected by clicking "Cancel".

The above applies to an EPG window opened in assessment mode (i.e. at the end of a test or when a saved file is opened). In therapy mode, the "Block" Frames" and "zoom" sections are replaced with a "Channel Select" feature. This allows the active EPG window to be assigned to either Linguagraph 1 or Linguagraph 2. Also, the "Spectrum" segment colour is not available in therapy mode.

Wave

The Wave Settings dialog box allows the appearance of the display to be changed.



A "Background Colour" of either grey or black can be selected by clicking the appropriate selector button.

"Text" for the title (e.g. "Combined Speech") and the Scale (e.g. 50%) can be turned on or off independently.

"Channel Select" allows the user to choose which channels to display – Speech, voicing, or both.

Channels are turned on or off by clicking in the appropriate selector boxes.

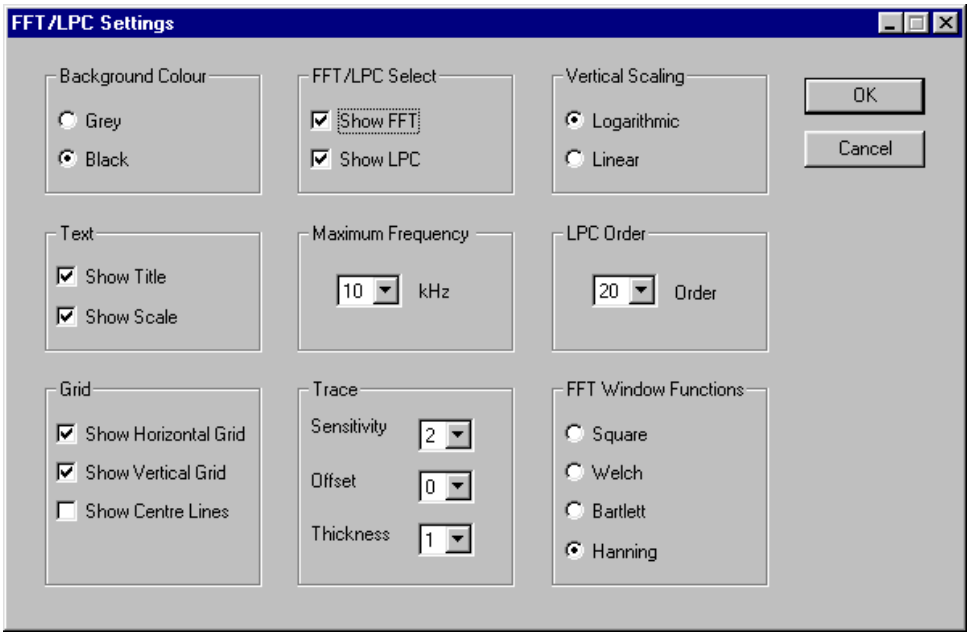
Trace Sensitivity (gain), Window (time duration) and Offset (which determines how much, if any, negative value is shown) can be adjusted, along with the thickness of the trace line, by clicking on the appropriate symbol and making a selection.

Finally, Horizontal or Vertical Grid lines can be switched on or off, or a pair of horizontal and vertical Centre Lines can be selected, by clicking in the appropriate selector box(es).

When all required selections have been made, they can be implemented by clicking "OK" or rejected by clicking "Cancel".

FFT/LPC

The FFT/LPC Settings dialog box allows various properties of the FFT/LPC display to be changed.



A "Background Colour" of either grey or black can be selected by clicking the appropriate selector button.

"Text" for the title and the Scale can be turned on or off independently.

Horizontal or Vertical Grid lines can be switched on or off, or a pair of horizontal and vertical Centre Lines can be selected, by clicking in the appropriate selector box(es).

"FFT/LPC Select" allows either an FFT plot, an LPC plot, or both to be displayed in a single window. If both plots are required, an alternative to displaying both in one window is to open one FFT/LPC window to show the default LPC, and then open a second window and change its plot to "FFT".

"Maximum Frequency" allows the user to select the full-scale value for the frequency axis. Values of 1 – 10 kHz can be chosen, by clicking on the appropriate symbol and making a selection.

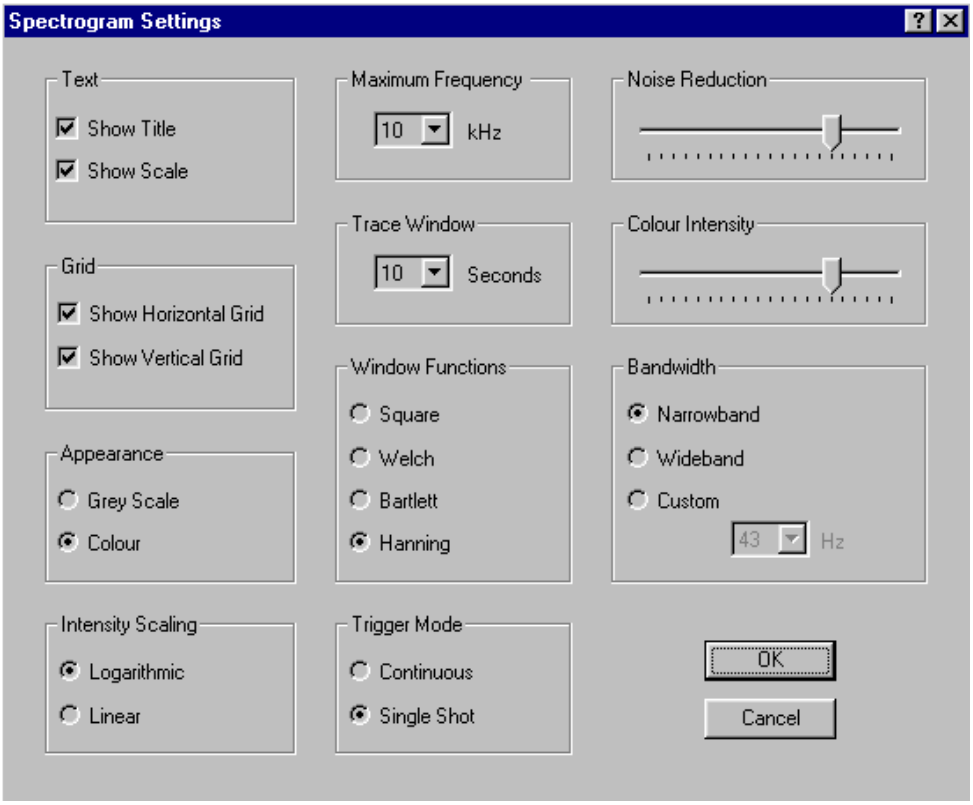
Trace Sensitivity (gain) and Offset (which determines how much, if any, negative value is shown) can be adjusted, along with the thickness of the trace line, by clicking on the appropriate symbol and making a selection.

The LPC order can be set to any value between 1 and 60. The default value of 20 generally provides a good compromise between resolution and speed of operation. In addition, various "Window Functions" can be selected for an FFT, which allow a trade-off to be made between spectral leakage and spectral smoothing. In most cases, the default "Hanning" window will provide the best result.

Finally, The vertical (amplitude) scale can be set to either logarithmic (default) or linear.

When all required selections have been made, they can be implemented by clicking "OK" or rejected by clicking "Cancel".

Spectrogram



"Text" for the title and the Scale can be turned on or off independently.

The horizontal and vertical grids (actually "tick marks") can be turned on or off independently.

The "Appearance" of the spectrogram can be changed from the standard "Grey Scale" (where the density of the black represents the intensity of the signal components) to "Colour" (where high intensity is represented by red, falling through orange, yellow, green and blue to black).

The intensity scale can be set to either logarithmic (default) or linear.

"Maximum Frequency" allows the user to select the full-scale value for the frequency axis. Values of 1 – 10 kHz can be chosen, by clicking on the appropriate symbol and making a selection.

"Trace Window" allows the user to select the time taken to scan along the horizontal axis, by clicking on the appropriate symbol and making a selection.

Various "Window Functions" can be selected, which allow a trade-off to be made between spectral leakage and spectral smoothing. In most cases, the default "Hanning" window will provide the best result.

In real-time mode, the Trigger Mode can be changed between "Continuous", where the trace automatically restarts when it reaches the end of the display, and "Single Shot", where the trace starts when a key is pressed and stops when it reaches the end of the display. In this mode, the trace can be restarted, after it has stopped, by pressing any key.

"Noise Reduction" allows the user to reduce the dynamic range of the spectrogram, this removing low-level noise and providing a cleaner (whiter) background. Note, however, that low-level signals will be removed as well as the noise.

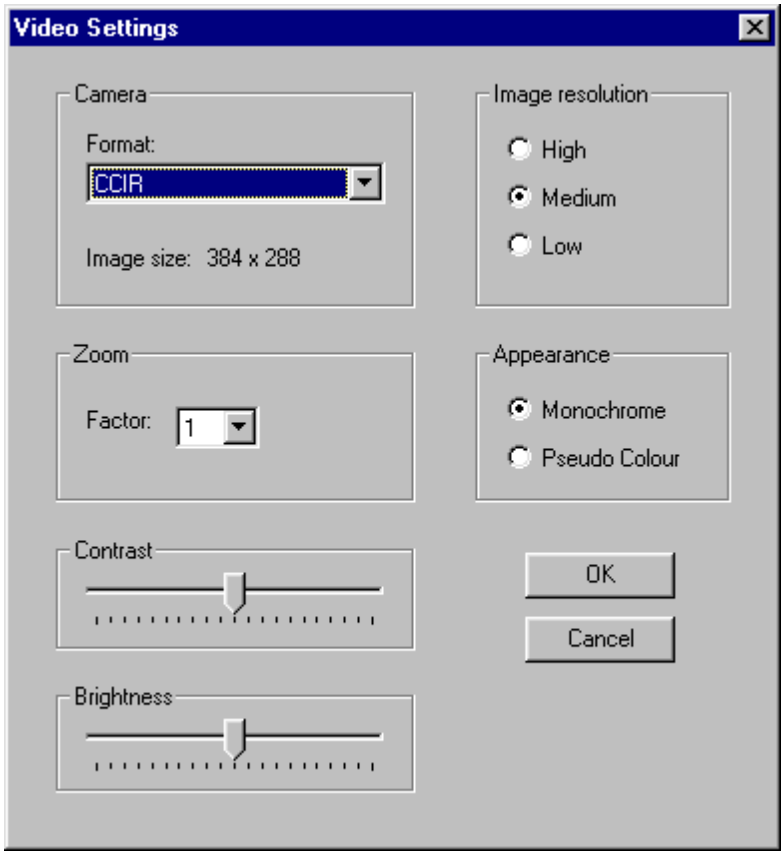
"Colour Intensity" is effectively a contrast control, which acts by increasing the intensity gain. It is often useful to increase the "Colour Intensity" after noise reduction has reduced the dynamic range.

Finally, the "Bandwidth" of the Spectrogram can be changed between Narrowband and Wideband. Custom selections are also possible.

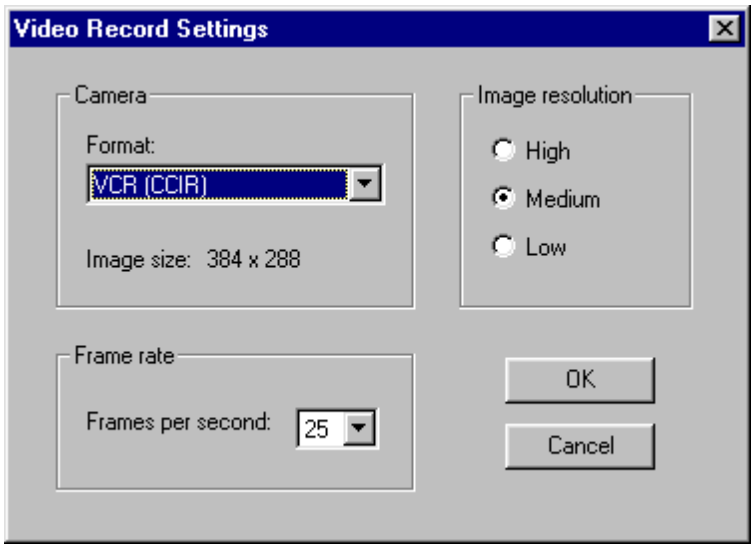
When all required selections have been made, they can be implemented by clicking "OK" or rejected by clicking "Cancel".

Video

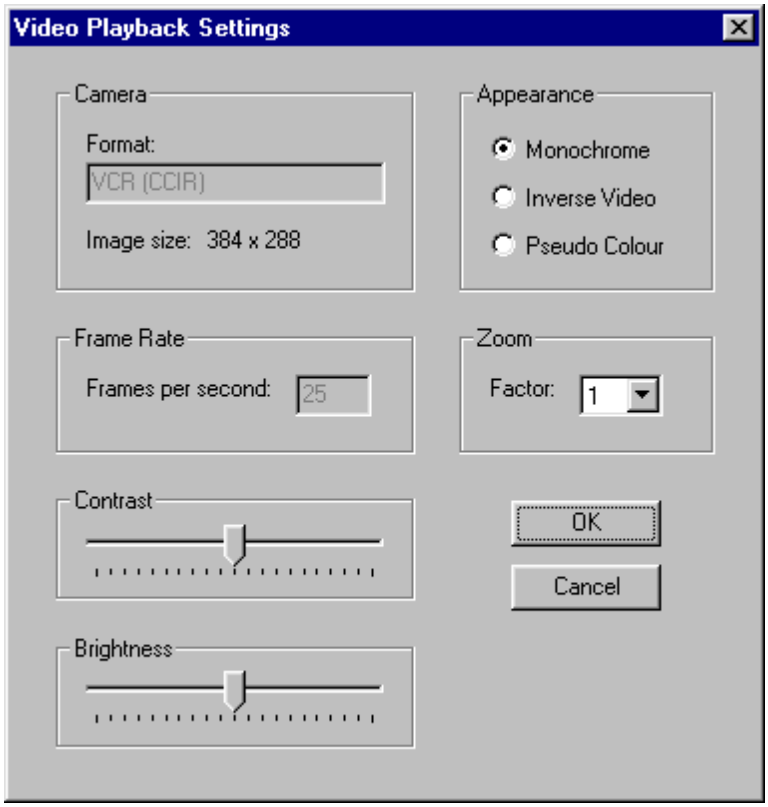
The Video settings dialog box allows the video capture (during Test), real-time image (during Therapy), or playback parameters to be changed. Different options are available at different times.



* Therapy Video Settings options



* Test Video Settings options



* Playback Video Settings options

The “Camera” format section of the Video Record Settings dialog box allows the appropriate video source to be selected. Formats commencing VCR… are designed specifically for recording from videotape. These should not be used with live sources. The “Image size” can be varied by selecting High, Medium or Low resolution from the “Image Resolution” section. The “Frame rate” can be set, as required. It is usually best to set the frame rate to match that of the video source.

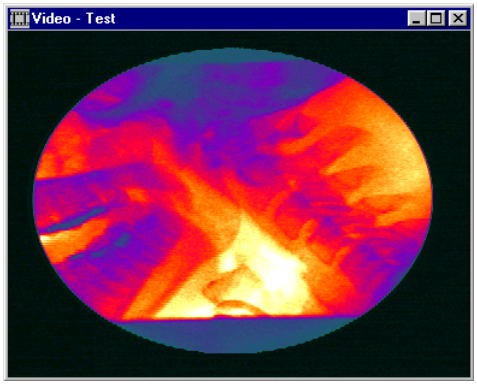
The “Contrast” and “Brightness” sliders can be used to alter these parameters on the displayed image. The stored image is not affected by their use. These controls operate in real-time, i.e. you can see their effect on the image as you move them.

The “Appearance” box allows either standard monochrome (default), inverse video or pseudo colour to be displayed. Inverse video is useful when images are viewed by those who are more familiar with viewing film X-rays, as these appear as negatives, compared to videofluoroscopy images.

* Standard (positive) image

* Inverse (negative) image

Pseudo colour images have “false colour” applied. This sometimes makes it easier to see edges and contours.

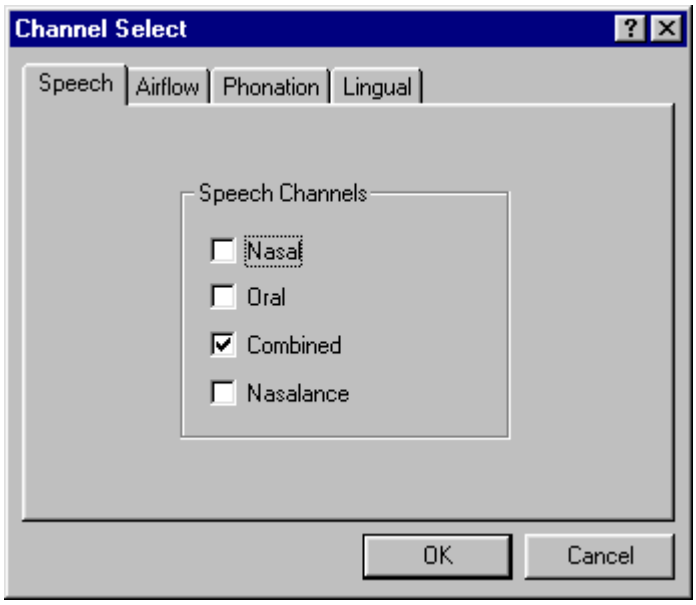


The “Zoom” selector allows the magnification of the image to be changed, i.e. it zooms-in on the image. Whenever the image is larger than the available window, scroll bars appear. These allow the portion of the image that is in view to be changed.

When all required selections have been made, they can be implemented by clicking “OK” or rejected by clicking “Cancel” (except for brightness and contrast, which are implemented in real-time.

Channel Select...

This dialog box allows the user to choose which Scope channels to display. Any number and combination of channels can be selected.



Channels are turned on or off by clicking in the appropriate selector boxes. Channels for parameters other than "Speech" can be accessed by first clicking on their tab.

When all required selections have been made, they can be implemented by clicking "OK" or rejected by clicking "Cancel".

Available channels are:

Speech channels

Nasal

The intensity (envelope) of the sound emanating from the nasal port.

Oral

The intensity (envelope) of the sound emanating from the oral port.

Combined

The total sound emanating from both the nasal and the oral ports, i.e. $nasal + oral$.

Nasalance

The percentage of the total **sound intensity** that is nasal, i.e. $\frac{nasal}{nasal + oral} x100\%$

[This is **acoustic** nasalance]

Airflow Channels

Nasal

The airflow emanating from the nasal port.

Oral

The airflow emanating from the oral port.

Respiration

The total airflow, i.e. $nasal + oral$

Ratio

The ratio of the difference between nasal and oral flows to the total flow, expressed as a percentage, i.e. $\frac{nasal - oral}{nasal + oral} x100\%$

Nasalance

The percentage of the total **airflow** that is nasal, i.e. $\frac{nasal}{nasal + oral} x100\%$

[This is **aerodynamic** nasalance (standard for SNORS+)]

Phonation Channels

Voicing

The envelope of the Laryngograph® Lx output.

Fundamental Frequency

The frequency of vibration of the vocal folds

Closed Quotient

The percentage of each cycle during which the vocal folds are closed

Short-term Jitter factor

The percentage variation of frequency of vibration of the vocal folds, over time.

Short-term Shimmer factor

The percentage variation of vocal fold amplitude of vibration, over time.

Lingual Channels

Alveolar

The amount of tongue-palate contact in the alveolar region (i.e. the front two rows of the palate) expressed as a percentage of maximum possible contact.

Palatal

The amount of tongue-palate contact in the palatal region (i.e. the middle three rows of the palate) expressed as a percentage of maximum possible contact.

Velar

The amount of tongue-palate contact in the velar region (i.e. the rear three rows of the palate) expressed as a percentage of maximum possible contact.

Left Lateral

The amount of tongue-palate contact in the left lateral region (i.e. the left two columns of the palate) expressed as a percentage of maximum possible contact.

Right Lateral

The amount of tongue-palate contact in the right lateral region (i.e. the right two columns of the palate) expressed as a percentage of maximum possible contact.

Midline

The amount of tongue-palate contact in the midline region (i.e. the centre four columns of the palate) expressed as a percentage of maximum possible contact.

Balance

The balance of tongue-palate contact left to right (-100% is fully left, +100% is fully right).

Weight

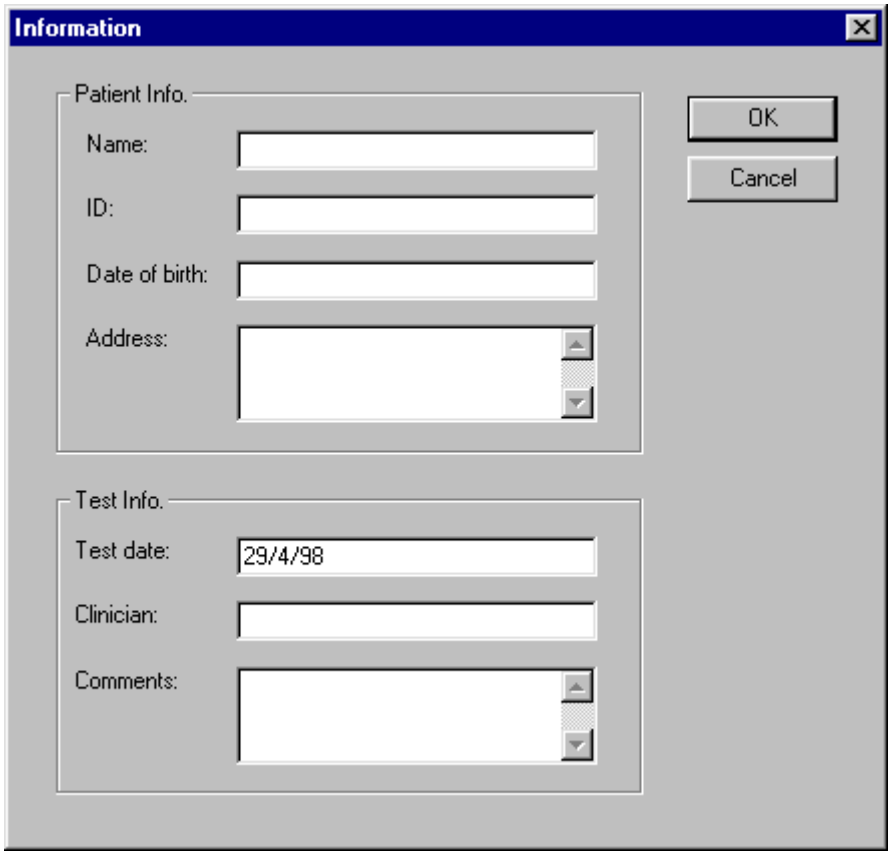
The weight of total tongue-palate contact over the entire palate expressed as a percentage of maximum possible contact.

Centre of Gravity

The position of the centre of gravity of the total contact area, front to back. 100% is fully forward and 0% is fully back.

Patient Info...

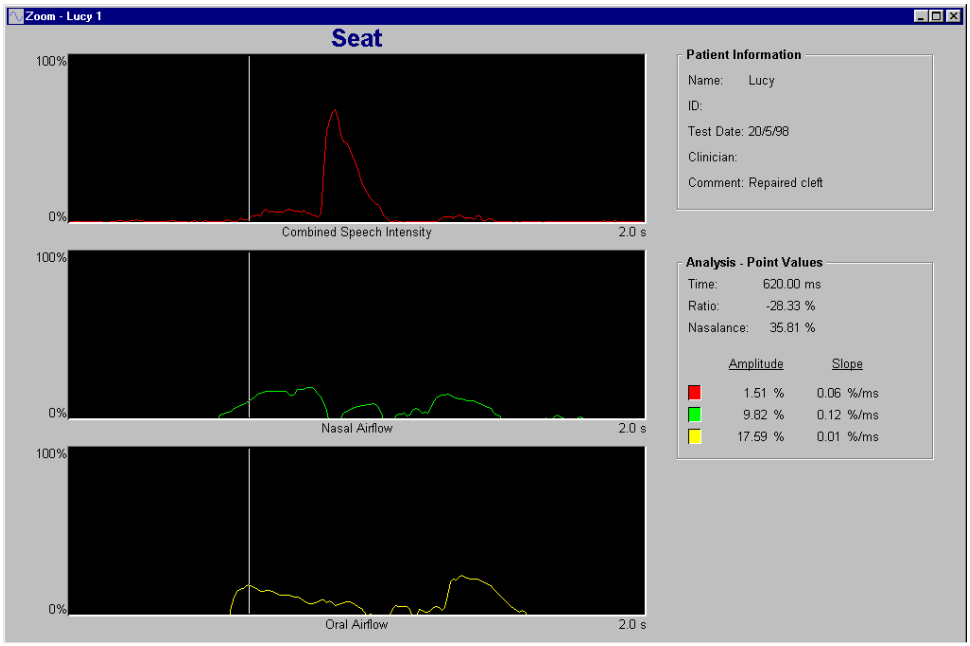
The "Information" dialog box that opens when "Patient Info." is selected allows the user to enter details of the patient being tested. Simply use the mouse to click in a box where it is desired to enter information and type in the details. The test date is automatically entered, but can be changed if required.



When all required selections have been made, they can be implemented by clicking "OK" or rejected by clicking "Cancel".

Show Track Cursor

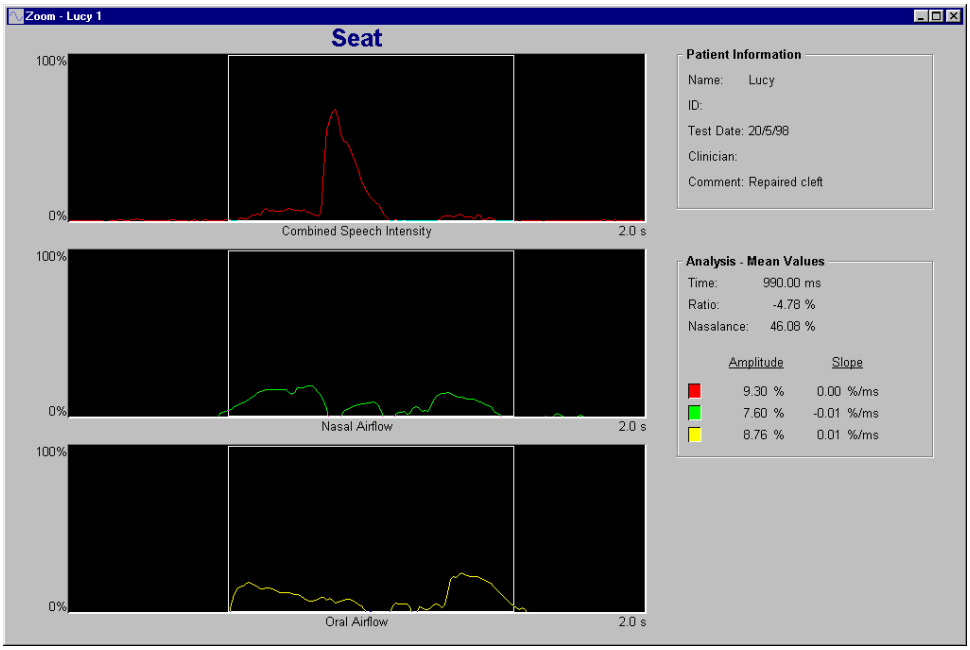
Clicking on this sub-menu item turns the Track Cursor on (if it was previously off) or off (if it was previously on). If the cursor is currently on, a tick appears to the left of the menu text.



If a Block Cursor is on, it will be switched off by selecting the Track Cursor – only one cursor can be on at a time.

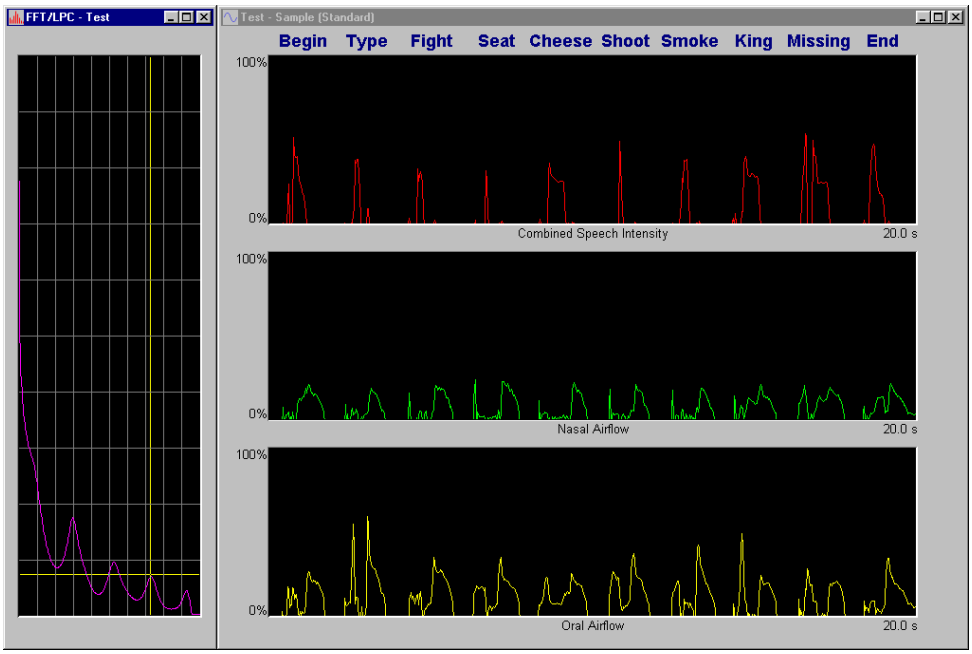
Show Block Cursor

Clicking on this sub-menu item turns the Block Cursor on (if it was previously off) or off (if it was previously on). If the cursor is currently on, a tick appears to the left of the menu text.

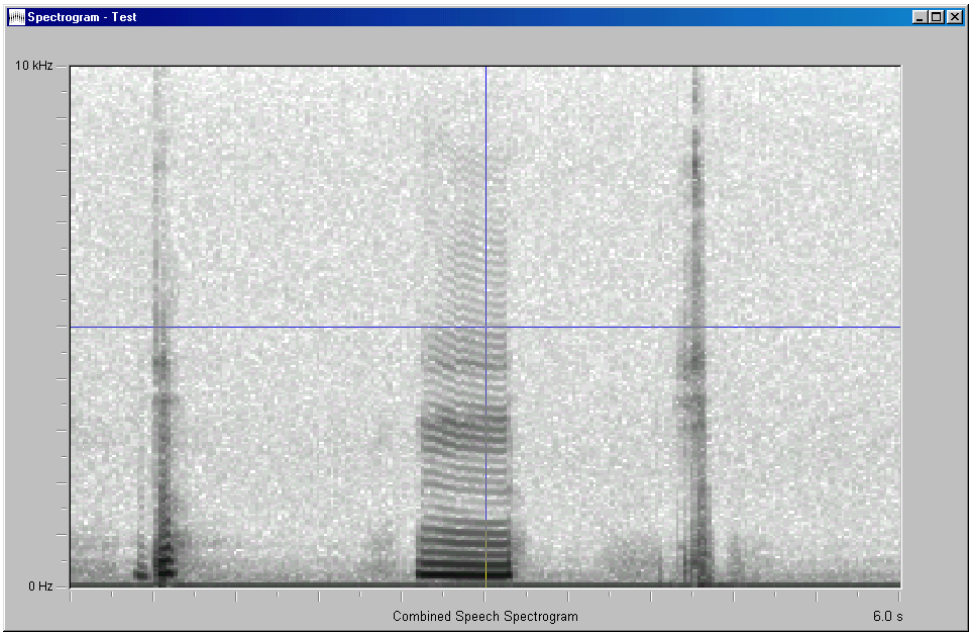


If a Track Cursor is on, it will be switched off by selecting the Block Cursor – only one cursor can be on at a time.

When the active window is an FFT/LPC, “Show Block Cursor” places a measurement cursor on the FFT/LPC.



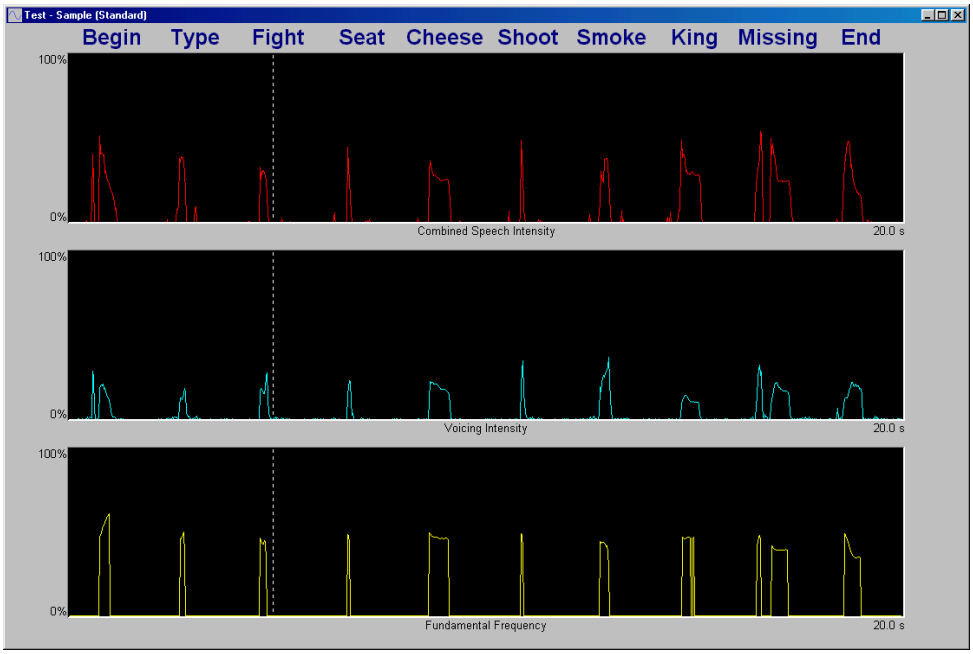
When the active window is a Spectrogram, “Show Block Cursor” places a measurement cursor on the Spectrogram.



Snow Animation Cursor

Clicking on this sub-menu item turns the Animation Cursor on (if it was previously off) or off (if it was previously on). If the cursor is currently on, a tick appears to the left of the menu text.

An Animation Cursor is a dotted cursor, which moves across the display in synchronisation with audio and/or video playback.



Show patient Info.

This option turns on or off the “Patient Information” display box in the Test window. If this box is currently on, a tick appears to the left of the text in the menu.

Show Analysis

This option turns on or off the “Analysis” display box in the Test window. It this box is currently on, a tick appears to the left of the text in the menu.

The “Analysis box” will display either “Point” or “Mean” values, depending on whether the Track or Block cursor is enabled. If neither cursor is enabled, analysis is not possible, and the analysis box title says, “disabled”.

[The above two figures (under “Show Track Cursor” and “Show Block Cursor”) display both patient Info. and Analysis boxes.]

View

Zoom

This option allows the user to zoom into a portion of the display, by dragging a rectangle over the required area, using the mouse.

The Zoom function resets after it has been used but can be reselected as many times as required.

Use

1) Select “Zoom”. The cursor changes to a cross.

2) Place the cursor at the start of the required area and press and hold the left mouse button.

3) Drag a rectangle to the end of the required area.

4) Release the mouse button. A new window appears, showing only the zoom region.

Note: “Zoom” only affects the time axis. Hence, it does not matter where (or even on which trace) the start and end points lie, vertically.

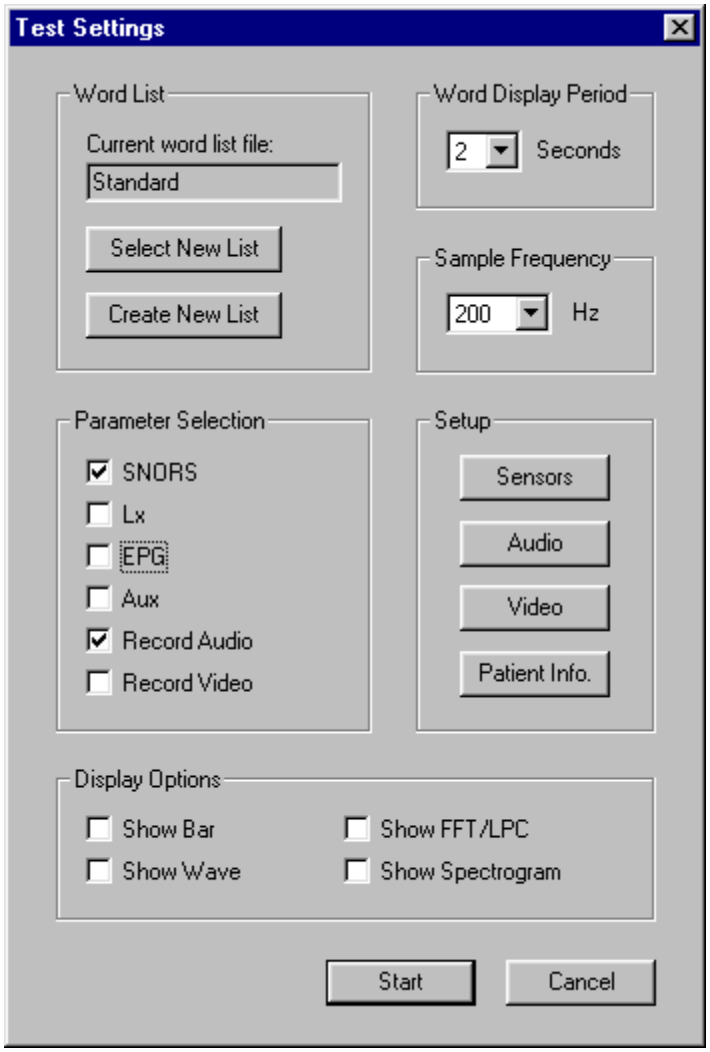
Test

Repeat Test...

Starts a repeat test.

The test Settings dialog box first opens, which allows selections to be made if required. Clicking “Start” starts the test.

This is the same as selecting “New”, “Test”, except that data for the current patient is automatically entered into the patient “Information” box. If required, this information can be changed (edited) by selecting “Patient Info.”.



For details of possible selections, see “New”, “Test”, above.

Show Bar

Allows the Bar"display to be shown or hidden.

Show EPG

Allows the EPG display to be shown or hidden.

Show Wave

Allows the Wave display to be shown or hidden.

Show FFT/LPC

Allows the FFT/LPC display to be shown or hidden.

Show Spectrogram

Allows the Spectrogram display to be shown or hidden.

Show Video

Allows the Video display to be shown or hidden.

Export Data

Provides export of the test trend signals to either the Windows Clipboard or a text file. All recorded traces are exported, whether visible on the Test display or not. Data are exported in tabular form, where each column represents a particular trend signal's data and each row represents a time-slice.

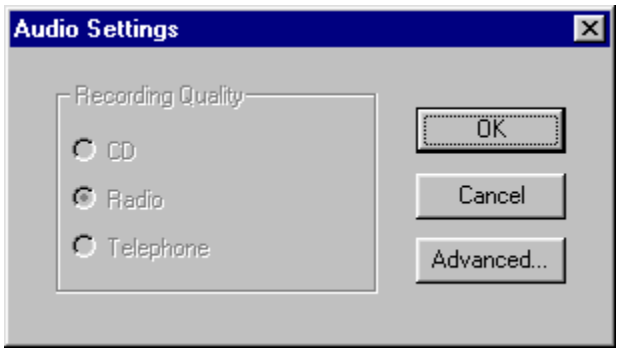
Export Analysis

Provides export of analysis data to either the Windows Clipboard or a text file. Analysis data for all recorded traces are exported, whether visible on the Test display or not. Data are exported in tabular form as a single column, where each row represents an analysis value, either at the position of the Track Cursor or averaged over the width of a Block Cursor.

Audio

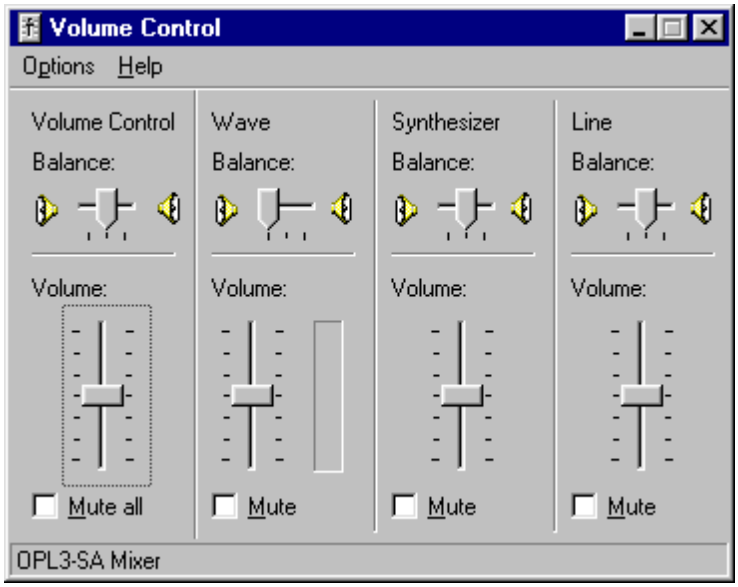
Settings...

This option opens the Wave Settings dialog box, which allows selection of audio recording quality and other "Advanced" parameters.



The default quality (Radio) uses a sampling rate of 22 kHz, which should be satisfactory for most purposes. If required, the audio can be increased to CD quality (44 kHz), or reduced to Telephone quality (11 kHz). It should be noted, however, that the higher the quality, the larger the files size! A standard test **without sound** requires just 23 Kbytes of disk space. The same test with "Telephone", "Radio" or "CD" quality sound occupies about 900 Kbytes, 1.8 Mbytes or 3.5 Mbytes, respectively.

Clicking the "Advanced…" button opens the standard Windows "Volume Control" dialog box.



This allows the user to alter the playback volume, using the "Volume Control" and/or "Wave" "Volume" sliders. It is also possible to listen to the Laryngograph® Lx signal, by moving the "Wave" "Balance" slider to the right. This signal, which represents voicing, will be heard a s a buzz.

Show Animation cursor

Clicking this menu item turns the animation cursor (dotted vertical line) on and off.

Window

Cascade

Displays all open windows as a cascade.

Tile horizontal

Arranges all open windows horizontally.

Tile vertical

Arranges all open windows vertically.

Auto Arrange

Automatically arranges all open windows.

Arrange Icons

Automatically arranges any iconised windows.

Close All

Closes all open windows.

1, 2, 3, etc

Switches between different windows.

Help

Contents

Displays the table of contents for the help system.

Search

Searches the help system for the specified topic.

Using help

Displays information about using the help system.

About...

Provides basic information about the SNORS+ program, including version number, licensed user, and copyright details.

Chapter
13

Specification

A list of the system's capabilities

Input channels

SNORS

- Nasal airflow (egressive & ingressive)
- Oral airflow (egressive & ingressive)
- Nasal speech intensity[12]
- Oral speech intensity[1]

Linguagraph

- Tongue-palate contact

Laryngograph®

- Voicing intensity[1]
- Fundamental frequency

Auxiliary Channel

- User-definable input channel

Sound card

- Sound Waveform (Sp)
- Laryngograph waveform (Lx)

Video card

- Video images

Scope channels available for display

- Nasal speech intensity[1]
- Oral speech intensity[1]

[12] Speech/voicing waveform, rather than speech/voicing intensity displayed in high-resolution mode.

- Combined speech intensity[1]
- Nasal airflow
- Oral airflow
- Combined airflow
- Aerodynamic nasalance
- Aerodynamic ratio
- Voicing (Lx) intensity[1]
- Fundamental frequency (derived from Lx waveform)
- Closed quotient (derived from Lx waveform)
- Short-term Shimmer (derived from Lx waveform)
- Short-term Jitter (derived from Lx waveform)
- Alveolar tongue-palate contact
- Palatal tongue-palate contact
- Velar tongue-palate contact
- Left tongue-palate contact
- Centre tongue-palate contact
- Right tongue-palate contact
- Tongue contact balance
- Tongue contact centre-of-gravity
- Tongue contact weight

2-D displays available

- Tongue-palate contact (**EPG**)
- Bi-directional **bar** (any two real-time scope channels)
- **Video** image

Wave displays available

- Sound Waveform (Sp)
- Laryngograph waveform (Lx)

Speech analysis displays available

- FFT
- LPC
- Spectrogram

Sampling rates

With electropalatography enabled

100 Hz or 200 Hz

Without electropalatography enabled

100 Hz – 900 Hz, in 100 Hz steps

1000 Hz – 10000 Hz, in 1000 Hz steps

Audio sampling rates (for Sp and Lx)

11.025 kHz, 22.050 kHz or 44.100 kHz

Video frame rates

Up to 30 fps

Channel bandwidths

Speech intensity

Signal bandwidth:	50 Hz – 13 kHz
Envelope[13] bandwidth:	DC – 30 Hz

Airflow

Sensor bandwidth[14]:	DC – 500Hz
Display bandwidth[3]:	DC – 30Hz

Lx

Signal bandwidth:	75 Hz – 1 kHz
Envelope[2] bandwidth:	DC – 30 Hz

[13] Envelope detection used for intensity displays.
[14] Standard (Lo-Res) operation uses “Display bandwidth”, optional Hi-Res operation uses “Sensor bandwidth”.

Channel sensitivities

Speech intensity:	Dependent upon Volume Control setting
Airflow:	-25 – 0 – 100 l min^{-1}
Lx intensity:	Dependent upon Sensitivity Control setting

Typical accuracy

Airflow:	3% full scale

Typical synchronisation

Audio:	$\pm$ 2 ms
Video:	To nearest video frame (maximum frame rate = 30 fps)

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